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Rhode Island Highway Testing Department

Survey of mineral resources in vicinity of each proposed job for information of contractors secures lower bid prices. Makes beam tests of concrete laid. Routine tests of materials and special tests of experimental materials and methods.

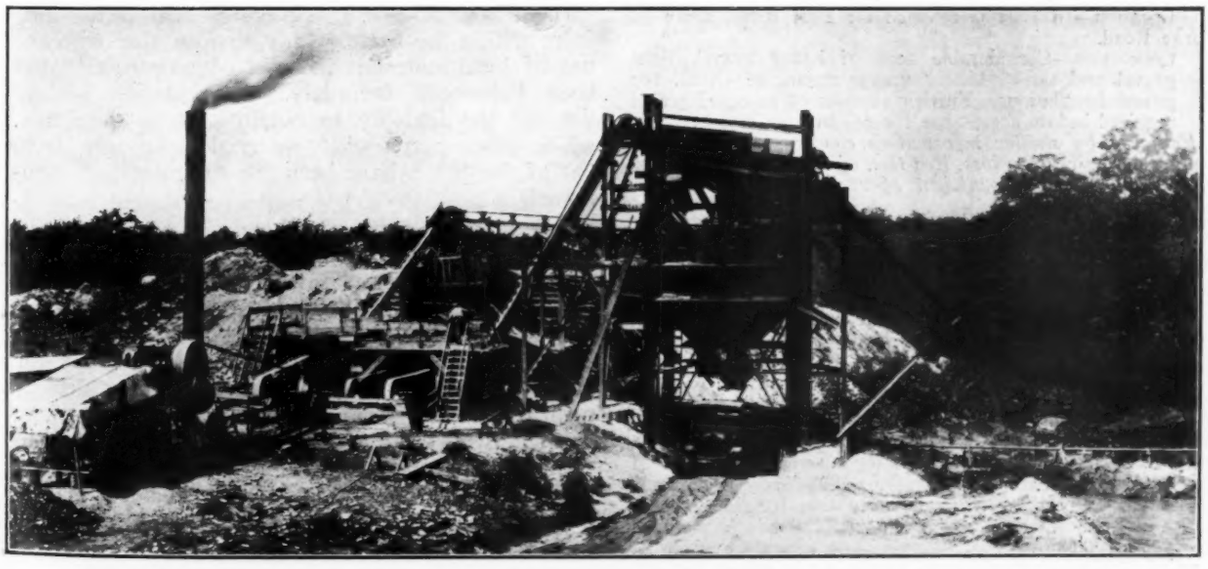
By David D. Bouchard

The Materials Testing Department of the State Board of Roads plays an important part in the construction of Rhode Island highways. From a small beginning in 1922, the department has developed into an efficient organization equipped to test all cements, aggregates, road oils and asphalt and bituminous mixes used by the State. Its work covers a survey of materials in advance of construction, the control of quality during construction and the keeping of detailed records for present information and future reference.

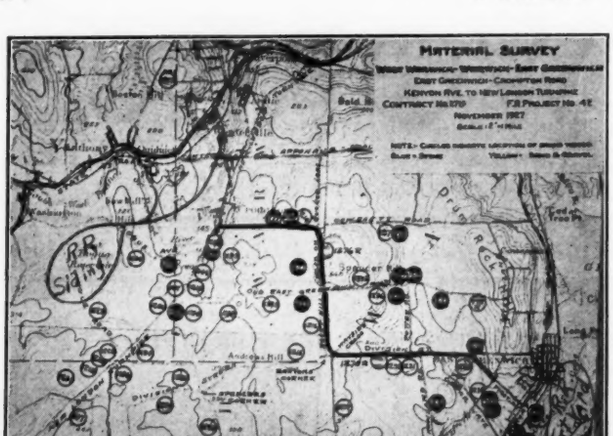
One of the paramount features of the department's work is its study of local materials, inaugurated primarily to assist bidders by supplying information as to the character and accessibility of local materials needed on various State projects. Since few contractors are equipped with testing laboratories or the time necessary to make a proper survey, the detailed information furnished by the department not only has been favorably received but has more than repaid the State in low bids.

Prior to requesting bids on a project, a comprehensive survey is made of mineral resources in the vicinity of the proposed job. Sand, gravel and ledge samples are taken to the laboratory and tested, and the results of the tests are filed. The tests determine the suitability of the materials for pavement surfaces, foundations, pavement bases and structures. The test pits and ledges are numbered and located on a map covering an area adjacent to the particular project to be constructed.

When the survey has been completed, all available information about the project is mimeographed and distributed to contractors. Not only does the information contain a discription of the character of nearby materials, but it gives the names of owners of the banks and specifies which deposits meet the requirements of the department. An estimate of



CRUSHING AND SCREENING PLANT AT LOCAL DEPOSIT APPROVED BY MATERIALS ENGINEER
Amount needed by contractor on two near-by jobs approximates 30,000 cu. yds. The state saves $1.25 per cubic yard over cost of imported material. Plant is operated without dust.



MAP SHOWING LOCATIONS OF BANKS AND QUARRIES TESTED
Road to be built indicated by heavy line

Some items of the information given re. contract No. 2,715, F. A. P., No. 421.

The principal items calling for local material are Gravel Foundations and crushed stone for base course.

Gravel suitable for gravel foundations may be obtained from Banks No. 439; 1,139, 1,117, 1,187, 1,189, 1,199, 1,232, 1,240, 1,275, 1,279, also possibly from Nos. 783, 1,190, 1,226, 1,238, 1,241 and 1,277.

Screened gravel samples passing for use in base course were obtained from Banks, No. 439, 1,139, 1,232, 1,240, 1,279, and possibly from Nos. 783, 1,187, 1,238 and 1,239.

Note: In order to use crushed gravel for base course, all material larger than 1" in diameter must pass through the crusher.

Sand samples showing sand acceptable for use in concrete masonry were taken from Banks Nos. 1,189, 1,191, 1,198, 1,240 and possibly from Nos. 1,177, 1,194, 1,199, 1,232 and 1,275.

Sidings for the importation of trap rock are available at the west end of this contract at West Warwick (7 cars) and at Quidnick (6 cars), and near the east end of this contract is a freight yard at East Greenwich.

Data on Sand and Gravel Banks

Bank No. 439.

Owner—Greenwich Bleachery.

Location—In East Greenwich off Post Road, south of Forge Road.

Conclusion—Considerable aera of heavy gravel, light gravel and sand. Heavy gravel should be O. K. for gravel foundations. Further samples of screened gravel required before acceptance for use in base course.

Followed by similar information concerning forty other banks, and percentage loss, Rea test, of screened gravel from each. Also French coefficient of rock from each of five stone quarries.

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approximate quantities of materials needed for the job also is listed, together with the probable extent of the local supply. The following statement by the department accompanies the printed report:

Results were obtained from tests on samples carefully taken from face of present pits or from test pits dug from 6′ to 12′ deep in undeveloped knolls. Gravel and sand deposits in the Rhode Island area, being of glacial origin, vary considerably in quality and it is beyond the scope of this preliminary survey to explore exhaustively each bank. Tests on samples taken from reasonable locations simply indicate that suitable or unsuitable material has been found at the points in question. There is no guarantee given or implied in this report that all material at a certain location will pass requirements, and material used on construction will be tested from time to time and required to keep within limits specified. Contractors are urged to visit various

Rhode Island State Board of Public Roads
RECORD OF RESULTS OF TESTS OF CONCRETE AND AGGREGATES

TOWN AND ROAD: Narragansett - BOSTON NECK ROAD — CONTRACT NO: 2617
Job Location: Hazard Corner - Narragansett Avenue - Kingston Road — F.A. PROJ. NO: 53
Type of Pavement: Reinforced Cement Concrete — Res. Engr.: Allen
Contractor: Amos D. Bridge's Sons - Hazardville, Conn. — Mat. Insp.: Dunham Tyler
FINE AGGREGATE: Sand From BANK NO. 450 — OWNER: Dibiasio
COARSE AGGREGATE: Crushed Stone From BANK NO. 4[illegible] — OWNER: Sullivan Gran. & M. Tray
BRAND OF CEMENT: Edison From New Village, N. J. — TESTS BY: Cylinders: Brown; Cement: Connell; Sand & Beams: Our Lab.
WATER FROM: Narragansett Town Water
SIZE OF CYLINDERS: 6"x12" METHOD OF CURING - In Moist closet (70°F.) to date of Test
SIZE OF BEAMS: 6"x6"x30" " " " - Field conditions until date of Test
MIX: 1-2-3 by volume — Approx. Water/cement Ratio
(Concrete made in field, Aggregates tested in Laboratory)

Cyl. and Beam Nos.	Lab. Serial No.	Date Cyl. and Beam Made	Sand Sieve Analysis: 4-20	P-50	P-100	Elutriation Silt %	Color	Sand Tension Test (Cement in Italics): 7 Day	28 Day	Slump	Compression Results and Modulus of Rupture (in Italics): 7 Day	*	28 Day	*	6 Months	*	Remarks
Specifications			50-60	5-25%	0-5%	3%		Specifications: Sand 10% Ottawa or Better			* = Character of Break (See Below) lbs. per sq. inch						
3320	6963	5/2	51.4	7.5	1.2	0.2	1	359(116) / *293*	387(104) / *367*	4"	2555 / *441*	B / *A*	3860 / *592*	C / *A*			3 Beams
3321		5/2								5	*480*	*A*					1 "
3322		5/4								4	*333*	*A*					1 "
3323	6979	5/4	47.4	13.0	7.4	3.2	2	352(124) / *284*	443(124) / *342*	2	2745 / *423*	AC / *A*	4490 / *549*	A / *A*			3 "
3324		5/5								4	*545*	*A*					1 "
3325		5/6								4	*380*	*A*					1 "
3326		5/7								4	*527*	*C*					1 "
3327		5/9								4	*640*	*A*					1 "
3328	7003	5/10	41.5	12.6	2.3	0.4	1	325(109) / *316*	415(118) / *350*	4½	2350 / *620*	AC / *B*	3710 / *723*	C / *B*			3(Trap Rk)
3329		5/10								4	*470*	*A*					1 Beam
3330		5/11								4	*559*	*A*					1 "
3331		5/12								3½	*541*	*C*					1 "
3332	7018	5/12	47.2	8.4	2.0	0.3	1	277(100) / *277*	392(107) / *368*	4	2240 / *519*	C / *B*	3700 / *312*	A / *B*			3(Trap Rk)
3334		5/15								3	*540*	*C*					1 Beam

SIGNED: John V. Kelly, Materials Engineer

* A-Across Aggregate B-Around Aggregate C-50-50
AC-Slight Shear

FORM FOR RECORDING RESULTS OF TESTS

points at which suitable material has been found and form their own opinion as to the amount and quality of material available. In most cases, test pits have been refilled.

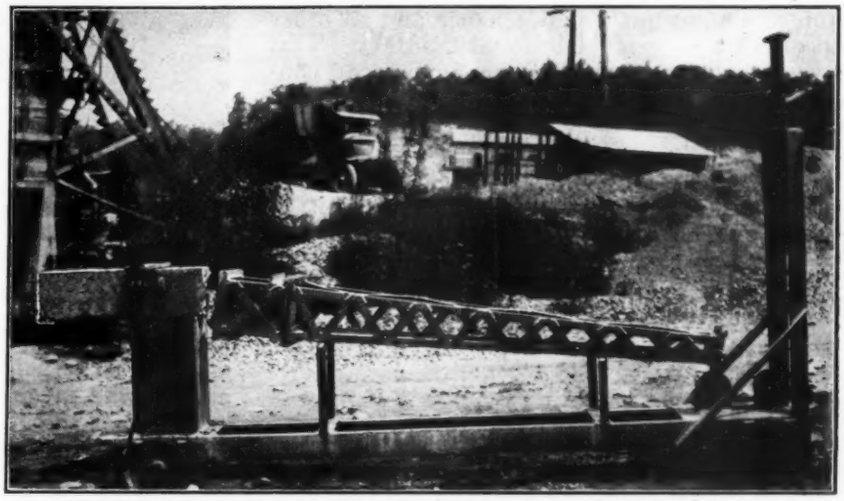
A complete record is available at the testing laboratory in the State House of all tests made on samples taken from any bank.

A detailed knowledge of local materials plays an important part in designing highways; and since the inauguration of the testing department, local sand, gravel and field and wall stone have been used without exception as foundation materials. A very large part of the pavement aggregates also have come from within the State. It is obvious that with the use of local materials the cost of construction has been influenced favorably. Also, serious delays through the inability to obtain prompt shipments, which often occur when material is brought from out of the State, have been for the most part eliminated.

The material surveys and tests have proved valuable to private citizens, contractors, public utility concerns and city and town highway engineers, as well as to State road builders, and many are the requests received by the department for information concerning the suitability of certain aggregates for various uses. It is the ultimate aim of the department to make a geological survey of the entire State from the viewpoint of the highway engineer, and to compile the results in map form so that it will be possible to determine at a glance the detailed character and adaptability of road building materials in any part of the State.

To the testing department should go in a large measure the credit for the general excellence of cement roads in Rhode Island. As a result of its

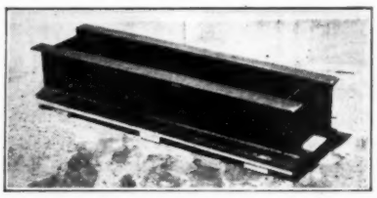
research work and laboratory experiments, the department has set up a standard of coarse and fine aggregates used in constructing local pavements. It specifies the cleanliness and toughness of coarse aggregates and requires fine aggregates in briquette form to equal standard results with Ottawa sand. The consistency of the mix also is specified. The department rules, too, that the amount of water used shall be changed only with the consent of the engineer in charge; and under no condition must it exceed five gallons per bag of cement.



BEAM BREAKING RIG AT LOCAL STONE QUARRY

The construction department takes great pains to see that the required standards are maintained. The resident engineer in charge of the job is responsible for the quality of the work. Together with assistants, he must check carefully all details of the project, exercising special care in testing materials, mixing, line and grade and other important features. As a further safeguard, regular visits are made to the job by the construction engineer, while twice weekly representatives of the testing department inspect each project.

An inspector is stationed at the mixer at all times. He keeps a detailed record of each step taken; the amount of water used, the time of the mix, conditions of subgrade, the number of batches per section, etc. At least once a day he casts a beam 6 by 6 by 30 inches of concrete from a representative batch. The beam is allowed to stand in its form 48 hours. It is then stripped and left by the roadside to cure under the same conditions as the pavement.



FORM USED FOR CASTING BEAMS. WEIGHT OF MOLD, 52.5 LB. WEIGHT OF WOODEN PALLET, 7.5 LB.

After seven days the beam is transported to a transverse breaking rig for a test. The stress imposed upon beams in this test is supposed to approximate the pressure to which pavement is ordinarily subjected. If the dynamometer on the rig records a minimum modulus of rupture of 400 pounds per square inch, the pavement is thrown open to trucks employed by the contractor. For that reason he, too, is eager to obtain satisfactory results.

Formerly the department tried the strength of concrete pavement by a series of compression tests exclusively. Since using the new type of cantilever set-up the department has been able to open up pavements to traffic at the end of two weeks, whereas under the old system a wait of three weeks was required. Several portable, transverse breaking rigs have been added to the department's equipment and at least one is allotted to each job. The simplicity and ease with which they are operated greatly facilitates the work. That they are easily transported, and the fact that they tend to speed up tests and give more accurate results with less cost than under the old method, also are in their favor.

On his semi-weekly visits, the material testing official examines the source of materials, takes representative samples of sand and gravel and casts several beams and cylinders from the concrete mix. Sand and cement samples are taken to the laboratory for tests, the cement principally to check bin tests previously taken at the factory. The beams and cylinders are brought to the State House, where they are broken at the end of seven days, 28 days and six months. The results are tabulated, carefully watched for quality and then filed for future use.

Tests on bituminous materials and mixes are carried on in the usual way. Department inspectors are stationed at the various projects and tests are made of mixes and materials. Also many samples are taken at refineries to avoid the necessity of sampling on the job and to eliminate the delay incidental to getting the results of the tests back to the job.

The testing department frequently works with the construction department testing stretches of road on which special materials for curing are being used or in which new materials are being tried out. Testing installation of corrugated metal culverts also is carried on to determine the relative merit of various kinds of metal under different conditions.

Abram Atwood is chairman of the State Board of Roads. George H. Henderson is chief engineer and John V. Keily is materials engineer. Under their direction the department has grown to its present importance. That it is important is clearly demontrated by the fact that the State has been saved approximately $50,000 this year on two contracts alone because bidders used local materials recommended by the testing department.

Financing North Carolina Roads

According to Frank Page, chairman of the State Highway Commission of North Carolina, it is estimated that the gasoline tax of four cents will this year bring well over $17,000,000 revenue, while the outlay for the year on roads, including

interest, sinking fund, maintenance and all other expenses, will reach about $10,838,000. This leaves a balance of $6,415,000 for new road construction, in addition to $1,700,000 available from the Federal Government. With the present tax continued, and considerably less than the present annual increase in automotive traffic, the State can increase its highway system at the rate of about 350 miles a year, in addition to maintaining the roads and paying interest and sinking fund on its road indebtedness, completely clearing its highway debt by the year 1952. The State has already invested $115,000,000 in roads.

A Massachusetts Concrete Road Job

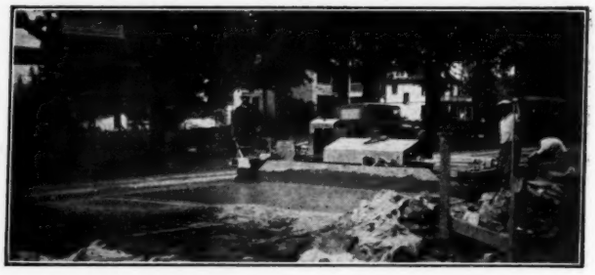
Traffic continued during construction necessitated more trucks. Setting reinforcement. Distributing calcium chloride

Up-to-date and interesting methods and equipment were used on a concrete road job, just completed, at Longmeadow, Mass., four miles south of Springfield. The work included the reconstruction of 5,500 feet of main highway. The pavement is reinforced concrete, placed in two lanes, each 15 feet wide, giving a total roadway width of 30 feet. The depth of the pavement is 8 inches, and the mix is 1:2:3 1-2. Expansion points are placed at intervals of 57 feet.

The old road, which consisted of sections of concrete and of asphaltic surfacing on a concrete top, was removed, and the base brought to approximate grade by steam shovels, of which three Eries and an Osgood were on the job. These removed the old surfacing and earth, the cut ranging from 12 to 20 inches. The spoil was loaded into Mack and Autocar truck for disposal.

Following the shovels, the subgrade was brought to section and elevation with a bladegrader, allowance being made for a sand layer under the concrete. The subgrade was rolled before and after placing the sand with an Acme roller and a Best tractor. The latter was especially valuable in working on the sand layer, the tread compacting the sand firmly, and better than it could be done in any other way.

Following the fine grading, the forms were set, Metaforms being used on this job. A Ransome 27-E mixer mounted on crawlers furnished the concrete. Aggregate was hauled from the rail point to a Blaw-Knox aggregate bin, from which it was carried in three Autocar 3-ton trucks to the mixer. These trucks were equipped with 3-batch bodies furnished with Heil hoists. Cement and hydrated lime were added at the mixer. The trucks were equipped with pneumatic tires, minimizing the damage to the subgrade; and their short wheelbase, allowing easy maneuvering in cramped space, was also quite an important factor.



LEFT FOREGROUND, REINFORCEMENT IN PLACE

Traffic on this road is very heavy, it being the main north and south road along the Connecticut river. The accompanying illustrations, which were taken on a rainy week-day, show the normal summer traffic on the road. This traffic interfered somewhat, though not seriously, with the work. It was the contractor's opinion that two trucks could have supplied aggregate to the mixer if there had been no traffic delays. The traffic also was inconvenienced somewhat, being sent in relays over the completed lane.

DISTRIBUTING CALCIUM CHLORIDE ON COMPLETED PAVEMENT

The employment of an Ord finisher closely following the mixer enabled the work to go on with a small mixer gang—only 12 men being required. An ingenious device was employed for facilitating the proper setting of the reinforcing. This consisted of three sections of 2-inch pipe, parallel to each

NORMAL TRAFFIC CARRIED BY RELAYS OVER COMPLETED LANE

other and to the axis of the road and about 3½ feet apart. These were attached to a cross-piece fastened to the mixer and were drawn by it, attachment to the crosspiece being so made as to allow some flexibility. The pipe sections were of sufficient length to cover one forward movement of the mixer. The mixer having moved forward, the reinforcing was placed on the sections of pipe, which supported it at the proper elevation above the ground. After the concrete had been placed, the forward movement of the mixer pulled the pipes ahead, leaving the reinforcing in place.

Following the finishing process, burlap was placed to protect the concrete until the initial set. Final protection and curing were accomplished by the application of 2 pounds per square yard of Columbia Chemical Co. calcium chloride. This was distributed by the slotted box method.

Frequent rains interfered with the progress of the work, and no record runs were made.

Daniel O'Connell's Sons, Inc., Holyoke, Mass., were the contractors, and R. M. Ahern was superintendent in charge of the work. J. J. Grady represented the Massachusetts Division of Highway as inspector.

Disposal of Packing House Waste by Irrigation at Laredo, Texas

By Chester Cohen*

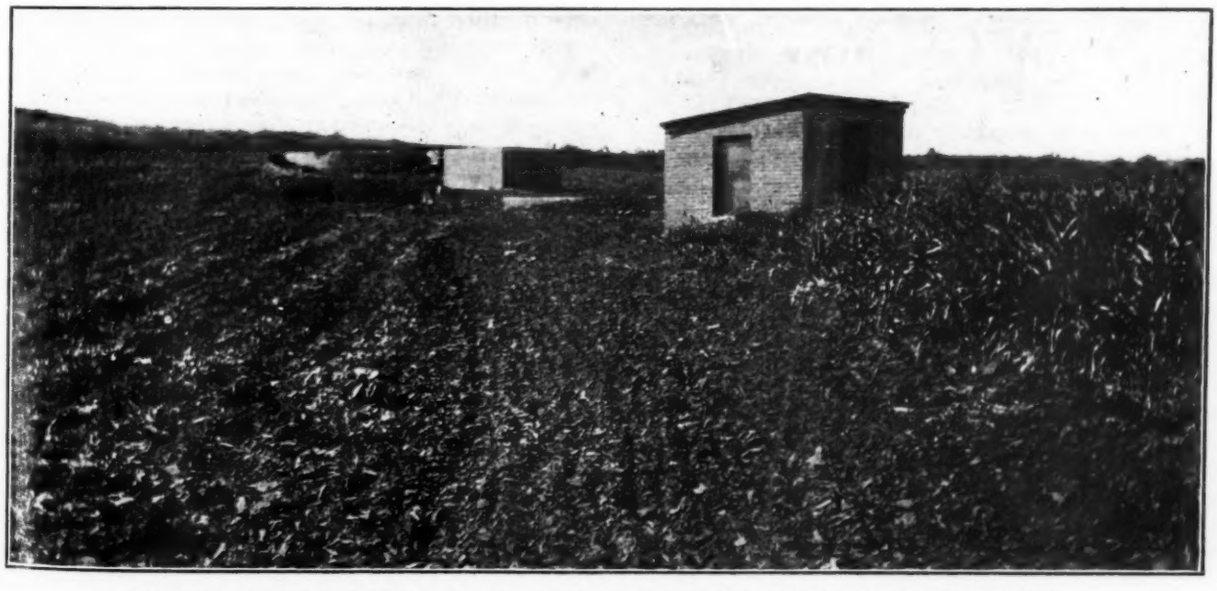
Recently the city of Laredo, Texas, threatened to force a local packing company to disconnect from the City sewerage system because of the extremely heavy quality of the waste which originates at the packing house plants. Prior to that time the Texas State Department of Health had not given serious consideration to the disposal of packing house and slaughter house wastes separately from sanitary sewage. In order to alleviate the situation at Laredo, treatment in septic tanks, the use of disinfectants and oxidizing chemicals were tried, but no single process was completely satisfactory.

The relatively high annual temperatures in and around Laredo and the porous character of the soil in that vicinity indicated that broad irrigation might prove successful in the disposal of these highly odorous packing house wastes. Accordingly two acres of land adjacent to the packing company's plant were cleared of brush and vegetation and ordinary parallel furrows about six inches deep were plowed across the two-acre plot to receive the wastes.

The combined sewage flow from the packing plant, consisting of killing-floor offal, wash water, and hot water from the drying vats, was discharged onto this land. These wastes contain a considerable amount of blood, paunch manure, fat, and minute particles of animal matter in suspension, all of which is highly putrescible and very difficult to handle in the ordinary domestic sewage. Disposal consists in discharging the flow into as many channels as are necessary to take care of a day's sewage. The following day another set of adjacent channels are used while the first are allowed to dry. Rotation of furrows or channels is continued all the way across the plot, and as soon as the channels dry, they are plowed in. This breaks the surface crust or film which has formed in the channels and assists in oxidation.

To date, this method seems to be the most economical process for the treatment and disposal of such heavy and highly organic wastes as originate in packing plants and slaughter houses. The Laredo layout was able to handle around seven thousand gallons of sewage per acre per day. The land is valued at approximately $125 per acre, and since the use of the land for irrigation causes no depreciation but rather a gradual enrichment of the soil, charges which could be assessed against the purification system include only labor and taxes. Labor cost covering part-time service of an unskilled workman and a horse and plow for about one hour per day, could be roughly

*Sanitary engineer, Texas Department of Health.



LAND WHICH HAS BEEN PLOWED AFTER WASTE DISTRIBUTED ON IT HAS DRIED

estimated as one dollar per day. The system has been in operation for something over two years, during which time no complaints have arisen regarding odors or other nuisances. Its continuation for an indefinite period is therefore intended.

The success of the Laredo experiment indicates the possibility of employing broad irrigation in the disposal of wastes from creameries, dairies, tanneries, and other industries producing a sewage capable of natural oxidation. The equally fortunate results which we have encountered in applying this same principle in the disposal of domestic sewage has warranted the recommendation of irrigation in other localities where there is sufficiently high temperature, little rainfall, and a rather porous soil. Many sections of Texas lend themselves favorably to such application and a number of cities in the western part of the state are employing irrigation as a part of their sewage disposal system. Abilene is able to handle six thousand gallons per acre per day if applied on land used solely for irrigation. If the sewage is used as an irrigant for crops, only 1,250 gallons per acre per day can be satisfactorily disposed of.

Observations of some fifteen Texas towns employing irrigation in sewage disposal lead to the conclusion that where sewage or other wastes are to be disposed of on land, no attempt should be made to utilize the land for the growing of crops. San Saba and Pecos irrigate pecan orchards with sewage, but here the soil is sufficiently exposed to sunlight as to cause no interference in the biological processes necessary for satisfactory disposal. Attempts to make the land serve for crop growing has usually resulted in the disposal of sewage becoming a secondary consideration. Nuisances and complaints of odors from stagnant water may then be expected. Mosquitoes will breed in pools of water which usually collect. The difficulty of handling the sewage during crop harvesting will tend to aggravate the problem further, and altogether the purpose will be defeated.

Power from Refuse in Glasgow

Plant with capacity of fifty million k. w. p. per annum, consuming nearly five hundred tons a day. Mechanical charging and clinkering Utilizing clinker

The city of Glasgow, Scotland, has put into operation this year what is said to be the largest plant in existence for obtaining power by the incineration of city refuse. The importance attached to the plant is indicated by the fact that Prince George attended the formal inauguration of it. The plant occupies an area of 15½ acres on the south bank of the Clyde. It cost about $3,000,000, and is estimated to have a capacity of at least 50,000,000 kw. h. per annum when consuming 480 tons of refuse a day. It is designed to operate twenty-four hours a day, six days in the week. It is divided into four sections or units, each capable of dealing with 160 tons of refuse per day, with the idea of operating three at a time, with the fourth retained in reserve in case one section should break down. In addition to the electricity, it is expected to produce commercially valuable clinker and scrap metal.

The nature of the plant was decided after a visit by officials to the leading works in England, and to those at St. Ouen, Nancy, Amsterdam and Rotterdam.

The refuse is collected and carried to the plant by a fleet of electric vehicles. These are not arranged to dump, which permits their being hung lower than would otherwise be possible, (thus facilitating loading) and also keeps down the dead weight. Instead, a dumping apparatus is provided in the reception house above the receiving hoppers.

The vehicles enter the dumping floor of the reception house by a ramp. The refuse, having previously been weighed, is discharged into four large receiving hoppers provided with special feeding apparatus for delivering it at a uniform rate into the separating and grading machinery below. Ample floor space is provided around the hoppers and at the upper end of the ramp, so that free entry and exit of vehicles is insured.

From the hoppers the refuse is discharged into four large revolving cylindrical screens which separate it into two classes, screenings and tailings.

Before leaving the screens, the tailings are brought under the influence of electro-magnetic separators which remove all tin and iron materials and deposit them in skips standing on the floor. When filled, the skips are carried by means of an overhead transport to an unloading and sorting platform where the galvanized and enameled ware are removed and the tin ware is passed to a detinning furnace adjacent to the sorting platform. Presses, mechanically operated, bale the metal refuse under a pressure of 60 tons into bales approximately 18″ x 12″ x 12″.

The tailings, after leaving the screens, are conveyed to pulverizing machines of the swinging hammer type revolving 960 r. p. m., each directly coupled to an electric motor of 35 horsepower through the medium of a friction clutch. The pulverized tailings are then combined with the screenings in conveyors traveling in a gallery below the screen house floor. These conveyors carry the mixed material to the incinerator house, which is a separate building some distance away from the screening house, in which the furnaces and boiler equipment are installed. In the incinerator house the material is discharged onto several conveyors which diverge for distributing the refuse to the main storage bunkers above the furnaces. These distributing conveyors are so arranged that the refuse can be delivered at any rate desired to any of the bunkers. The material is distributed evenly throughout each bunker by means of reversible shuttle conveyors mounted upon traveling carriages.

The furnaces are charged hydraulically, the apparatus for this consisting of a container linked up to the top feeding door and coupled to a hydraulic ram so that a movement of the ram in one direction opens the feeding door and discharges the contents of the container into the furnace, while the reverse movement closes the door and replaces the container

under the bunker in readiness for the next charging. The furnaces are divided into eight units, each consisting of five cells, a total of forty cells.

The grates are of the latest type designed for mechanical clinkering and recovery of heat. They are movable in a forward and backward direction, the power for operation being provided by hydraulic rams. On the backward movement of a grate, the clinker is deposited on an auxiliary grate below, and cooled by the air used for forced draught which passes through the clinker until the next clinkering operation, when the clinker on the lower grate is discharged down a chute at the rear of the furnace into a wagon. By means of hydraulic valves fixed to the furnace front, the whole cycle of operation of charging and clinkering is controlled, the valves being interlocked to insure proper sequence. The air control dampers also are interlocked with these hydraulic valves.

Underground galleries with narrow-gauge railways are provided, through which the clinker and flue dust are handled by means of skips and storage battery locomotives; galleries being provided for removing flue dust from the boilers, flues and chimneys while the plant is in full operation.

Each furnace unit is complete with combustion chamber and provision for dealing with carcases, etc., either by means of a large top feeding door or large doors placed on the ground level. In connection with these doors, elevating tackle is provided for lifting carcases, thereby eliminating all handling except by mechanical means. From the combustion or gas-mixing chambers the hot gases are taken direct to water-tube boilers which are fitted with superheaters, automatic feed-water regulators, and soot blowers for tube cleaning. Four of the boilers are provided with coal furnaces, which normally will not be used, but can be used in case of an emergency.

The generating plant is housed in a separate building adjacent to the incinerator house and consists of two 5,000 k. w. turbo alternators for supplying 3-phase 50-cycle current at 6,500 volts, the speed of the steps being 3,000 r. p. m. The current from alternator terminals at 6,500 volts is taken to two frequency changers and then at 25 cycles to two banks of single-phase transformers, passing out to the bus bars at 22,000 volts.

The clinker from the furnaces is carried by an overhead traveler and grab from the dumping pit either to the crushing and grading plant or to cars on the railroad siding which passes diagonally through the plant. The dumping pit is divided into three compartments, so that if necessary one or more can be flooded with water for quenching purposes; a motor-driven centrifugal pump being provided for removing the water when desired.

The crushing and grading plant consists of crushers, elevators and screens in duplicate, delivering into large overhead storage bins which have outlet doors for loading railway cars or trucks. Space is also provided for storing crude clinker. In a separate building near the incinerator house is machinery for the rapid manufacture of concrete slabs and curbs, consisting of a mixing and grinding pan mill and hydraulically operated press, with all auxiliaries for convenient handling of the slabs.

A large, well-lighted garage provides accommodation for the electric collection vehicles and the necessary motor generators and panels for charging the vehicles, and also the service station equipment necessary for reducing the voltage for this and other purposes.

The entire plant was supplied and erected in accordance with designs furnished by Heenan & Froude, Ltd., of Worcester, England, which firm furnished and erected the screening house machinery, complete refuse handling plant, and the mechanically operated furnace and their accessories, clinker crushing and grinding plant, slab plant and dust plant.

Refuse Collection in Germany

Early this year the Westminster (England) city council authorized the city cleansing surveyor, F. W. Cable, to inspect the methods of collecting and disposing of refuse employed in various German towns. Mr. Cable, a little later, submitted his report to the council, from which the following information is abstracted.

In Cologne, special cans are provided by the municipality to all the householders and these are collected bi-weekly by a small motor car which draws a trailer, the two units taking in all twenty cans. These are conveyed to one of two or three depots where the cans are emptied by a patent process on to a jig conveyor, which conveys the refuse to a bucket elevator, which in turn raises it to a sufficient height to deliver it into a large refuse truck for immediate transportation to the dump. In putting the refuse into the trucks, the truck is placed underneath a telescopic canopy, the cover of the truck is opened mechanically and the telescopic hood descends so that it is not possible for any dust to escape while the elevator is feeding the refuse into the body of the wagon. These trucks carry a load of five tons, and draw a trailer of similar capacity which is loaded in the same manner.

While the refuse is being carried along the jig conveyor, the dust in suspension is sucked off, but is discharged again into the refuse before discharging into the truck; the object being to prevent the dust coming through the cracks of the closed-in conveyor. All street sweepings are discharged on to this jig conveyor from a small pit at one end.

As soon as the cans have been emptied, they are put into a washing machine and washed with water under pressure, the water having disinfectant mixed with it. The small vehicle and trailer, having unloaded the cans, proceeds around to the other side of the building and re-loads with empty disinfected cans for distribution to the dwellings in place of full ones collected.

At Mannheim Mr. Cable saw two types of refuse collecting vehicles. A Krupp collecting wagon is loaded from one end by means of dust cans which are a patent of Schmidt & Melmer, of Weidenau, and the same as those used in Cologne. The unloading here also is entirely dustless, but the cans are dumped into a small hopper at the rear of the wagon and a screw continually in operation carries the refuse up at an angle to the top of the front part of the wagon, where it discharges it on both sides. This

screw is enclosed for half its length, the remainder being in a trough. The great drawback to this means of loading is that when the front part gets filled up, it is necessary to tip the wagon so as to bring the refuse to the rear end and then lower the body again to its normal position. This has to be done two or three times during the process of loading. Also the wear and tear on the screw must of necessity be very great. He noticed that two of the vanes of a screw which he inspected were broken, and saw one of the screws being re-welded in the shop.

The other vehicle used in Mannheim consists of a cylindrical steel body, inside of which another cylindrical body fitted with vanes revolves continuously. It is loaded in the same manner as the Krupp vehicle, but the material is distributed by means of the revolving body and it it not necessary to tip the entire cart. The material is discharged from the cart by the revolving of this inner body. However, Mr. Cable doubted whether the vanes and moving parts of this vehicle were sufficiently durable for the service demanded of them. The vehicle is capable of carrying six and a half tons of refuse.

The city of Frankfort uses 24 Krupp machines for collecting about 400 tons of refuse per day. Owing to the very narrow streets in parts of the city, small electric vehicles are used in these streets which collect the cans and take them to one of the depots where they are loaded into the Krupp vehicles. This increases the cost by about 36%.

Hamburg uses 16 vehicles of the Trommel-Wagen system, and burns about 35% of the refuse in a destructor, dumping the rest. When the wagons reach the destructor, the bodies are slung off and raised up and the refuse is dumped out onto the floor and later fed to the furnaces. The rubbish can be emptied into these wagons more quickly than in the case of the other type. He was satisfied that this is the best system which he saw. He found it entirely dustless, very quick in operation, and with practically no chance of any damage through cans getting out of shape or through unnecessary moving parts.

Experimenting with Sludge Lagooning at Waco, Texas

Difficulties found when employing customary methods. Mixing raw solids with activated sludge in lagoons caused trouble. Short stay of sewage in presedimentation tank found desirable

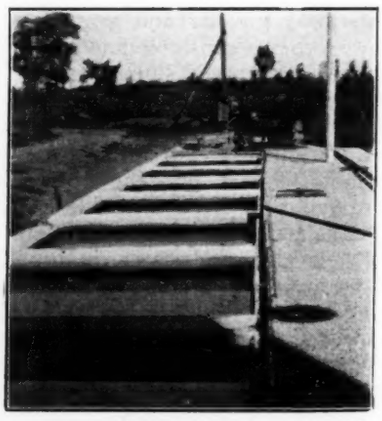
By V. M. Ehlers and Chester Cohen*

In September, 1927, the new sewage treatment plant for the city of Waco, Texas, was put into operation and since that time its performance has been carefully watched by Clyde C. Hays, city chemist and bacteriologist, upon whom devolves the duty of checking results. The plant was designed after the manner of the Indianapolis plant to combine preliminary sedimentation, activated sludge production, and final settling, discharging the resultant sludges into earth lagoons for final digestion.

The treatment units embrace grit chambers; two pre-sedimentation chambers with 55-minute capacity; activated sludge tanks, Manchester type, which allow six and a half hours' aeration; and Dorrco tanks for clarification. According to the plans as originally made, in the beginning of plant operation sludge from the pre-sedimentation tanks was discharged into earth lagoons. But the porous character of the soil allowed the liquid to be absorbed quickly, leaving undigested solids in the lagoons. The absorption of the liquor apparently caused the digestive process to cease and this was not actively resumed until water was added, either by rainfall, ground water infiltration, or from water mains. After the addition of water, a very rapid acid fermentation set up, resulting in a highly odorous condition.

*Chief sanitary engineer and district engineer, respectively, Texas State Dept. of Health.

WACO SEWAGE DISPOSAL PLANT



PRESEDIMENTATION TANKS, WACO

Left background, operator and compressor house. Left foreground, three 35 ft. clarification tanks. Right, three pairs of aeration tanks. Beyond tanks, presedimentation tanks

It was then attempted to overcome the acid condition by adding lime, but this proved impracticable because of the lack of facilities for mixing. Lime was added at the surface and at the inlet to the lagoons, but no thorough mixing with the sludge could be accomplished. During warm weather and directly after a rain, fly breeding went on apace, and that combined with offensive odors caused the population within a radius of one mile of the plant to complain bitterly.

In order to overcome the evils into which the plant operation had unwittingly dropped, one of the preliminary settling tanks was commandeered, covered, vented, and properly baffled to receive activated and raw sludges as a final digestion chamber. As soon as a sufficient amount of digested sludge has accumulated it will be removed and placed on land. The lagoons have been abandoned for the present and stand as mute testimony of the failure of one more sewage experiment. This confirms W. Dewitt Vosbury's prescription that successful sludge digestion requires a proper proportion of sludge to water, a proper proportion between acid neutralizing agents and sludge, thorough mixing and agitation of the sludge, and regular withdrawal of small amounts.

When the plant was first put in operation it was decided to follow the customary practice of maintaining 20 percent sludge in the activated sludge tanks, which gave a concentration of 1.0 percent solids by weight in these tanks. Mr. Hays thought that better results could be obtained if the percentage of solids was reduced to 0.75. Upon withdrawing one of the presettling tanks from its original use and converting it into a digestion tank, the retention period of the raw sewage was reduced, and on the other hand, a 6 percent increase in the amount of activated sludge returned to use, or a 26 percent concentration by weight.

It was also shown that activated sludge alone could be disposed of in the earthen lagoons without causing any nuisance or fly breeding (although this is not generally true of Texas plants), and it appeared that the difficulties arose from mixing the raw solids with the activated sludge.

Again, when both units of the pre-sedimentation tank were used, the retention period was sufficient to remove 85% of the settleable solids from the raw sewage. After several months' operation it was decided that too great a percentage of the solids were being removed for best results in the activation units. By cutting out one of the pre-sedimentation tanks, only 60 percent of the solids were removed. In other words, it was demonstrated that at the Waco plant a shorter period of retention in the pre-sedimentation tank is preferable to a longer period.

Parking of Sewage Plant Sites

Independence, Kans., has paid special attention to the appearance of its sewage treatment plant and the grounds around it. It has planted flower beds and lawns and there is, according to "Kansas Municipalities," "a spic and span appearance that is only occasionally seen in city parks. In fact, we wouldn't hesitate to recommend this as a place for picnic lunches."

Neodesha also is credited with similar care as to the appearance of its plant site; and both plants have been using chlorine this summer for odor control by means of W. & T. pedestal type chlorinators.

Typhoid Fever in Large Cities

As in previous years, the American Medical Association has collected data concerning typhoid fever in the cities of more than 100,000 population for the year 1927, figures having been obtained from 81 cities. The figures were unobtainable for some cities because unavailable in the records of the health departments.

The twelve cities in New England averaged a

Occurrence of 0.0 typhoid death rates in the large cities of the United States

1919	Spokane	1926	Albany
1920	Yonkers		Utica
1922	New Bedford		Yonkers
	Providence		Youngstown
	Yonkers	1927	Canton
1923	Norfolk		Kansas City, Kan.
1924	Fall River		New Haven
	Hartford		Paterson
1925	Lowell		Richmond
	Scranton		Springfield
			Yonkers

Death rates from typhoid in 1927

Honor roll (from 0.0 to 2.0 deaths per hundred thousand)

Canton	0.0	Boston	1.1
Kansas City, Kan.	0.0	Norfolk	1.1
New Haven	0.0	Detroit	1.2
Paterson	0.0	Jersey City	1.2
Richmond	0.0	Rochester	1.2
Springfield	0.0	Indianapolis	1.3
Yonkers	0.0	New York City	1.3
Providence	0.4	Newark	1.3
Bridgeport	0.6	Philadelphia	1.4
Camden	0.7	Erie	1.5
Chicago	0.7	Syracuse	1.5
Minneapolis	0.7	Trenton	1.5
Scranton	0.7	Dayton	1.7
Cambridge	0.8	Reading	1.7
Elizabeth	0.9	San Francisco	1.7
Lynn	0.9	Baltimore	1.8
Milwaukee	0.9	Hartford	1.8
Omaha	0.9	Washington	1.8
San Diego	0.9	Grand Rapids	1.9
Spokane	0.9	Pittsburgh	1.9
Cleveland	1.0	St. Louis	1.9
Los Angeles	1.0		

First rank (from 2.0 to 5.0)

Columbus	2.0	St. Paul	2.8
Flint	2.1	Tacoma	2.8
Portland	2.1	Kansas City, Mo.	2.9
Oakland	2.2	Toledo	2.9
Salt Lake City	2.2	Utica	2.9
Fall River	2.3	Louisville	3.1
Buffalo	2.4	Worcester	3.1
Youngstown	2.4	Wilmington	3.2
Lowell	2.6	Albany	3.3
Duluth	2.7	Des Moines	3.3
Seattle	2.7	New Bedford	3.3
Akron	2.8	Cincinnati	3.9
Denver	2.8	Fort Worth	4.3

Second rank (from 5.0 to 10.0)

Houston	5.6	Jacksonville	7.2
San Antonio	5.7	El Paso	7.9
Oklahoma City	6.4	New Orleans	8.0
Dallas	6.6	Tulsa	8.7

Third rank (above 10.0)

Birmingham	12.9	Memphis	14.5
Atlanta	14.0	Nashville	16.0

death rate per hundred thousand of only 1.26 while in 1926 it was 1.51, both lower than for any other section of the country. There were no deaths in New Haven and Springfield.

For the middle Atlantic States the average was 1.41, as against 2.09 in 1926. The highest rate in the group was 3.3 for Albany. Paterson and Yonkers had no deaths, the latter for the second successive year.

In the South Atlantic States, Richmond was the only city with no deaths, while Atlanta had 14.0, holding the same uneviable position among the cities of this group as for the past twenty years, with practically no improvement for the past ten years. The average for this group was 3.39; omitting Atlanta it would be 2.52. Last year it was 5.38.

The East North Central States also contained one city, Canton, which had no typhoid deaths last year. The maximum rate was 3.9 at Cincinnati. Taking the average for the past twenty years, Chicago has the best record, with consistent progressive improvement throughout this period. The average for this group was 1.31; in 1926 it was 1.69.

The highest group averages are found in the East South Central and West South Central cities, the former being 10.07 and the latter 6.71. In the East South Central Louisville had the minimum record of 3.1 and Nashville the maximum of 16.0. In the West South Central Fort Worth led with 4.3 while the maximum was 8.7 at Tulsa. Every city in both groups except Birmingham showed a much lower record than in 1926.

In the West North Central States, Kansas City, Kan., reported no deaths and the maximum was 3.3 at Des Moines. The average for this group was 1.86. In 1926 it was 2.22.

The Mountain and Pacific group averaged 1.74, with a minimum of 0.9 for both San Diego and Spokane and a maximum of 2.8 for both Denver and Tacoma.

Arranged in the order of group averages for 1927, the geographical divisions rank as follows: New England—1.26; East North Central—1.31; Middle Atlantic—1.41; Mountain and Pacific—1.74; W. North Central—1.86; South Atlantic—3.39; W. South Central—6.71; E. South Central—10.07.

Comparing the averages for the past 18 years of all but seven cities from which data for the full period are not available, we find a decrease from 20.58 in 1910 to 1.96 in 1927. This decrease was continuous except for slight increases in the years 1913, 1921 and 1925 over the year immediately previous.

Separate Sludge Digestion Experiences[1]

Concluding paper of series on this subject. Digestion capacities of the seven plants studied. Summary and conclusions after inspection during two years of operation

By Anthony J. Fischer[2]

In a previous article (PUBLIC WORKS, May 1928) the operation of sedimentation units at a number of separate sludge digestion plants was discussed. Close observation has shown that digestion is going on in a satisfactory manner at all these plants and that scientific control at the start practically eliminates difficulties such as are encountered at most plants during the initial operating period.

1 Paper No. 77, Department of Sewage Disposal, N. J. Agricultural Experiment Station, New Brunswick, N. J.
2 Dorr Sewage Research Fellow.

DESIGN FEATURES

The digestion units studied may be separated into three general classes according to their design features:

(1) Covered tanks of the gas collection type with mechanical stirring devices, such as at Antigo, Wis., Storm Lake, Iowa, and Sioux Falls, S. Dak.

(2) Tanks with stirring devices but without tight covers, such as at Hartford, Kiel and Sheboygan, Wis., and

HARTFORD, WIS., SEWAGE TREATMENT PLANT

(3) Plain hopper bottom tanks without mechanisms such as at Ridgewood, N. J.

The stirring mechanism and general design features of the gas collection type of digester at Antigo have already been described in detail (PUBLIC WORKS, March and April, 1928). The Storm Lake tank is similar, while those at Sioux Falls differ only in design of gas vents and domes.

The open and semi-closed type digester mechanisms differ in that they have a set of arms that rotate about four inches above the surface of the liquid. These arms are built in the form of channels from which are suspended heavy chains that hang in the liquid. The function of these chains is to assist in breaking up scum. The raw sludge enters the digester at the center and is distributed over the entire surface by the revolving channel arms. The semi-closed type of tank differs from the open type in that the former has a wood cover supported by I beams. The Antigo tank is the only one in which the sludge is heated, although that at Storm Lake is also provided with heating coils.

DIGESTION CAPACITIES

Table 1 gives the sizes of the units at the plants studied. The present capacities on the basis of population and on the basis of amounts of sludge received per day are given also. These capacities are figured up to a point 18 inches below the overflow pipes. The volumes per pound of solids received per day were calculated, assuming an average suspended solids removal (primary settling tank only) of 50% at Kiel, Sheboygan, Antigo, and Storm Lake; 60% at Hartford; and 70% at Ridgewood and Sioux Falls. The capacity at Ridgewood is reduced because of the fine screenings added. The same is true of the Storm Lake plant, because here the digester also receives sludge from a final settling tank.

This table shows that the per capita capacity of the Ridgewood tank is low while that for Sioux Falls is high. This extermely low capacity at Ridgewood is due in part to the position of the overflow pipe which extends down four feet below the liquid surface so that the ratio of effective depth to total depth is only 0.7. At the other plants, this ratio varies from 0.8 to 0.9. However, even assuming the entire capacity could be utilized, the design capacity would be only 0.82 cubic feet per capita.

The Sioux Falls plant was designed to take care of the waste from a local packing house in addition to the city sewage. This industrial waste amounts to about 1.7 m. g. d. Its suspended solids content is 1,250 p. p. m. Assuming a removal of 80% on the basis of dry solids, this waste is equivalent to a contributing population of 191,000.

A comparison of capacities calculated on a population and on a dry solids basis indicates that the latter show greater fluctuations due to the different strengths of sewage, suspended solids, removals, etc., and also shows that when screenings, secondary tank sludge or industrial wastes are digested, much larger per capita capacities should be provided.

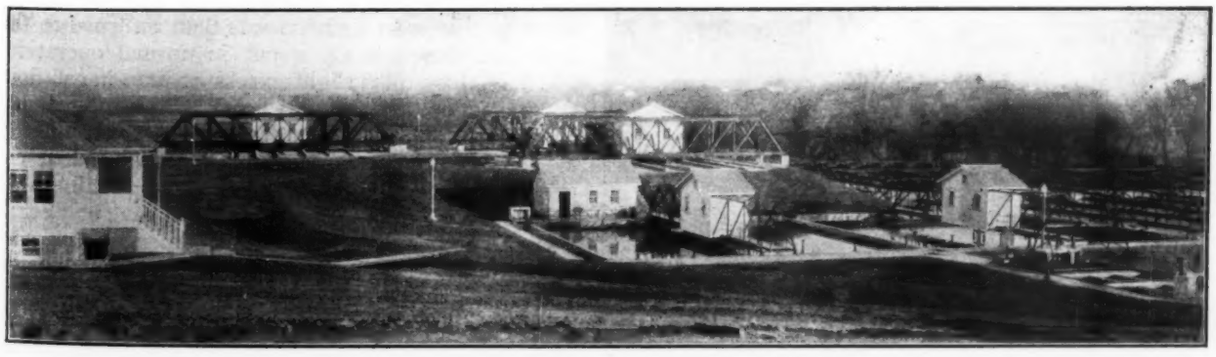
HARTFORD, WIS.

The Hartford digester has been in operation since August 1924 and has always been producing a satisfactory sludge. When this plant was started, ripe manure was added as "seed." Later experience at Kiel, and at Sheboygan, have shown that this is of

Table 1—Sizes of Units at Plants Studied

Plant	Population—Design	Population—Estimated present contributing	Size of Digester	Effective sludge storage capacity	Cu. ft. per cap.—Design	Cu. ft. per cap.—Present	Cu. ft. per pound dry solids added per day
Hartford, Wis.	5,500	2,770	38′ dia. x 14′ 3″ s.w.d.	14,750	2.68	5.32	51.7
Kiel, Wis.	2,000	1,040	25′ dia. x 15′ s.w.d.	6,260	3.13	6.02	100.0
Sheboygan, Wis.	5,000	2,000	36′ dia. x 16′ 10″ s.w.d.	15,800	3.16	7.90	105.0
Antigo, Wis.	10,000	5,600	50′ dia. x 17′ s.w.d.	28,000	2.80	5.00	73.7
Ridgewood, N. J.....	20,000	8,500	30′ x 30′ sq. x 15′ deep*	11,550	0.58	1.36	16.1 (2)
Storm Lake, Iowa.....	5,000	3,000	30′ dia. x 23′ s.w.d	13,160	2.63	4.38	39.2 (3)
Sioux Falls, S. Dak (1).	53,000	28,000	85′ dia. x 25′ s.w.d. (Three)	379,000	7.15	13.54	179.0 (4)

*Plain hopper bottomed tank. All others are equipped with mechanisms.
(1) Large capacities due to large amount of packing-house waste.
(2) Digester receives fine screenings and settled solids.
(3) Digester receives sludge from primary and secondary settling tanks.
(4) At present, with packing house waste coming in, estimated volume per pound solids added per day equals 23.2 cub. ft.



GENERAL VIEW OF SIOUX FALLS PLANT, SHOWING TWO CLARIFIERS AND THREE DIGESTERS

doubtful value. During the first year of operation, there were about 12 inches of light greasy scum present. This did not build up to a greater thickness presumably because of the stirring action of the mechanism. During the next summer this scum blanket gradually decreased to about two inches in thickness.

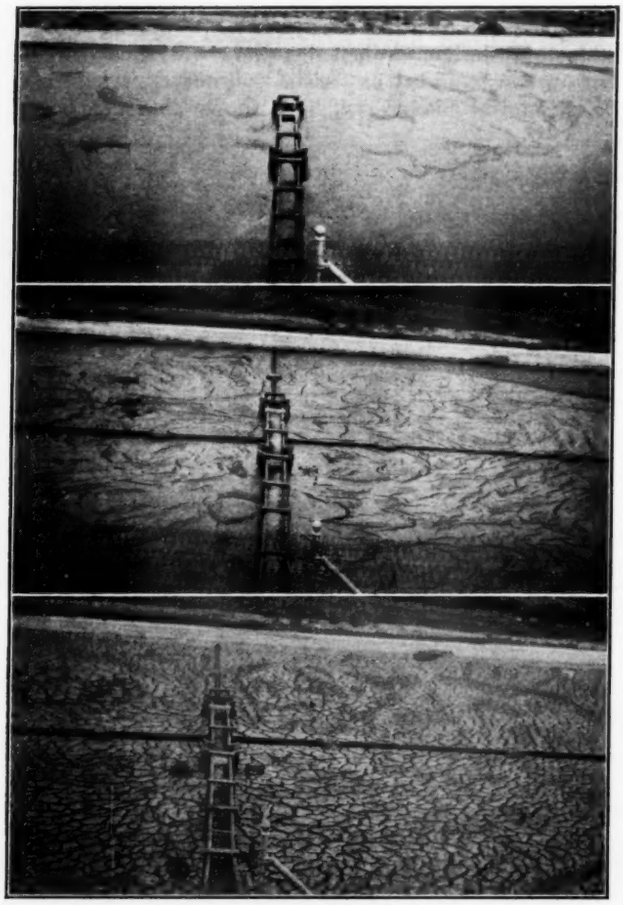
Extensive tests show that this digester received about 270 pounds of total dry solids per day. Of this, 100 pounds are gasified and 6 pounds of the suspended solids are liquified and go out the overflow, along with 6 pounds of solids in suspension. This shows that the percentage reduction in solids is 37%. As the raw sludge has a volatile matter content of 74%, and that of the digested sludge is 56.8%, the corresponding reduction of volatile matter is 53.8%.

Normally the pH value of the liquid is about 6.8 to 6.9. The sludge is slightly alkaline (pH 7.3). In cold weather these values tend to drop off slightly because of retardation of digestion. Lime was added to adjust the reaction to pH 7.3—7.6 but did not appear to have any effect, probably because enough ripe sludge was present.

Digested sludge is drawn about twice a year to a depth of 12 to 14 inches on the sand beds. This sludge contains about 6% solids, is black in color, inoffensive and dries rapidly. Tests made showed the following solid contents after various time intervals:

	Percent Solids
Sludge as drawn	6.0
After 1 hour	6.5
After 1 day	13.4
After 2 days	16.0
After 3 days	18.1
After 4 days	19.9
After 5 days	20.2
After 6 days	22.8
After 12 days	30.0

The average depth of sludge on the drying bed was 13.7 inches. Cracking of the sludge was evident after 28 hours, althought there was a heavy rain immediately after sludge was drawn.



HARTFORD, WIS., SLUDGE DRAWN TO AN AVERAGE DEPTH OF 13.7 INCHES ON BED; AFTER 1 DAY, 2 DAYS AND 5 DAYS RESPECTIVELY

KIEL, WIS.

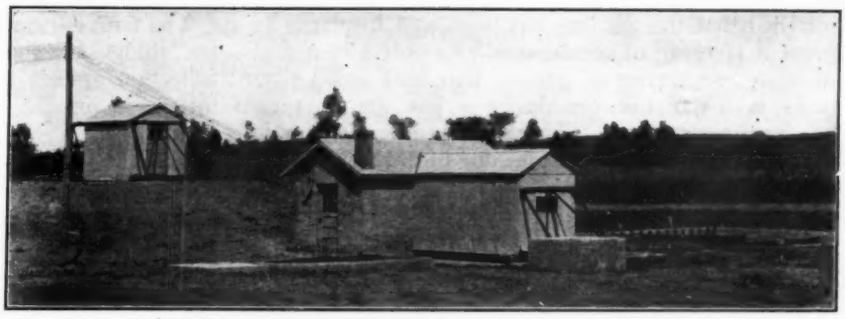
At Kiel the plant was started in January, 1926, manure being used as "seed." The folowing July, when tests were started, there was no scum in the digester. The sludge, however, was decidedly acid (pH 5.6) and had a low ash content, showing that no digestion was taking place. To correct this acid condition and establish a more favorable medium for bacterial activity, lime was added to raise the pH value to 7.4. Eighteen hundered pounds of lime as calcium hydroxide were required for this purpose. It was added in two batches. Action started almost immediately, and two days later a thick layer of scum appeared in the tank. This scum was light gray in color, of light consistency and full of gas. Its thickness varied from 20 to 24 inches until the middle of September when foaming began. At this time the scum rose 11 inches above the liquid level, giving a total thickness of 33 inches and entirely submerging the top arms of the mechanism.

As cold weather was approaching, it was thought better to start the tank anew instead of allowing it to continue until the following summer when conditions would probably be worse. So, the bottom sludge was drawn off. After it had dried sufficiently it was removed from the beds. This sludge was gray-black in color and although not thoroughly digested, was comparatively inoffensive. A large amount of lime was then added to the tank to sink the scum so that it could next be drawn off. Only a small part went to the bottom, however, despite the high alkalinity. A portable pump was then used to remove the remaining scum to the drying beds. The high alkalinity of the liquid was next reduced by diluting it with raw sewage. The partly digested sludge first drawn was then returned to the tank and the plant again put in normal operation.

There was still a slight excess of lime in solution, the pH value of the liquid being 8.2 and the sludge 8.9. This did not appear to have any serious effects, as gas evolution was very rapid, showing that digestion was going on. The high pH value was soon reduced by the incoming raw sludge. Scum was absent until the following summer when a six-inch layer appeared. This reduced to about one to two inches as ripe sludge built up. Since then no difficulties have been experienced with this unit except on one occasion when all the ripe sludge was drawn off by the operator. This resulted in

temporary scum formation such as is observed when a tank is first put into operation.

The conditions that led up to the starting difficulties at Kiel can be directly attributed to the severe weather prevailing in Wisconsin during the winter months. Normally when raw sludge is added to a tank it goes to the bottom. The temperature being favorable, this sludge starts to digest, with the production of large volumes of gas, which carries the sludge to the top, where it remains for some time until digestion nears completion. It again sinks and remains on the bottom, where digestion is carried out to completion with the production of ripe sludge. This cycle is dependent on a number of factors, chief of which are temperature, presence of ripe sludge, and pH value, probably in the order named.



KIEL, WIS., SEWAGE TREATMENT PLANT

At Kiel the digester was started in January without seeding with ripe sludge. Under these conditions, large amounts of acid substance form which inhibit further bacterial action. As the raw sludge was added daily, these acids accumulated so that further action was practically stopped, even when temperature conditions became more favorable. Thus, the sludge remained at the bottom in a dormant state, no scum being formed.

As soon as the acids were neutralized with lime, however, the gassifying bacteria became active and practically all the sludge was raised to the surface by the large volumes of gas produced. This scum prevented the escape of gaseous products of decomposition and resulted in "foaming." Unfortunately, a large number of disposal plants are started up in the winter time when digestion is impaired. Often this is unavoidable, and an acid sludge is produced. The experiences at Kiel indicate that it is inadvisable to add lime to adjust the pH value under these conditions. The best possible procedure appears to be the complete withdrawal of sludge from the tank when warm weather starts and then to adjust the reaction so as to secure most rapid digestion. In this way much smaller amounts of lime will be required, and danger of over-liming will be minimized. It is much better to add small amounts of lime daily than to add large amounts less frequently. The latter may cause difficulties due to a "precipitation effect" with the formation of a thick lime sludge at the bottom of the tank and consequent clogging of the sludge line.

When foaming occurs in a tank containing ripe sludge, it is much better to pump out the scum and allow the sludge to remain.

SHEBOYGAN, WIS.

At Sheboygan, the plant was started in October 1925. The same conditions, as far as digestion was concerned, were experienced here as at Kiel. The following June, when tests were started, the pH value of the sludge was found to be 6.2, so lime was added. In this case, however, scum did not appear, although digestion was materially hastened as shown by vigorous gas evolution. Lime addition was controlled by pH value determinations. During a short period these pH values were read on the tank liquid only. As the lime caused a precipitation of the solids and settled at the bottom of the tank this caused over-liming of the sludge while the liquid was still acid or only slightly above the neutral point.

This excess lime gave a pH value of about 10.0 in the bottom sludge and retarded digestion until it was neutralized by the incoming raw sludge. The retardation was not as great as if no lime were added at all. Tests made at different depths after liming showed that the pH value increased with depth, the greatest variations being in the sludge layer. This shows the absolute necessity of taking samples at various depths in a tank in pH control work. Samples taken only in the liquid layer or at the sludge-liquid junction will not suffice.

The first year's operation at Antigo has already been described. This plant continues to give excellent results. Averages of figures obtained from F. Quimby, city engineer, since November 28, 1927, are given in table 2.

Table 2:—Average results at Antigo, Wis., for 26 Weeks Beginning November 28th

Average daily gas, 4,760 cu. ft. = 0.85 cu. ft. per capita.
Average raw sewage temperature day 50.5°, night 48.2°.
Average maximum air temperature 41.7° (highest 94°).
Average minimum air temperature 15.6° (lowest 30° below zero).
Average digester liquid temperature 73° (highest 80°).
Average digester sludge temperature 80° (highest 85°).
Average heating water temperature, day: 121.8° in; 103.8° out.
Average heating water temperature, night: 119.1° in; 102.9° out.
Average heat exchange (24 hours) 17.0°.
Average heating water circulation 1,980 cu. ft. per day.
Average heat added, 2,070,000 B.T.U.'s per day.
Average heat lost, 1,699,000 B.T.U's per day = 0.8 B.T.U.'s per pound of material in digester.
Average heater efficiency (taking 1 cu. ft. gas = 700 B.T.U.'s), 62.2 per cent.

It is of interest to note that the average sludge temperature is seven degrees higher than that of the tank liquid. The sludge temperature at the side of the tank (nearest the heating coils) averages less than two degrees higher than in the center. The liquid temperature is uniform throughout.

As the average heat exchange during the last six months has been slightly higher than during the first year of operation it may safely be asumed that there has been no sludge caking around the coils with an ingoing hot water temperature of 120 degrees; otherwise the heat exchange would have been lower.

The proposed new gas dome has not yet been

installed, but the gas line has been well insulated to prevent freezing of condensate. As only a thin film of scum, consisting of grease, hair and wood particles, is in the tank, practically no gas line clogging has been experienced. There has been considerable corrosion of piping and heater due to the high carbon dioxide content of the gas. This has been cut down somewhat by increasing the draft. It is doubtful whether this can be eliminated even by use of a gas scrubber, as the methane burns to form water and carbon dioxide.

Samples collected in May showed that the average solid content of the sludge was 9.95%. The bottom sludge contained 11.5% solids, of which 62.5% was ash.

RIDGEWOOD, N. J.

The Ridgewood digestion tank was started in August, 1926. It is 30′x30′x15′ side depth, and has a 10′ inverted pyramid hopper. The entire tank is covered by a gas-tight concrete roof.

In the operation of the plant the fine screenings and settled sludge were pumped to the digestion tank, the overflow from the latter tank being returned to the sedimentation unit. The digestion tank was seeded at the start with a small amount of ripe sludge. This was insufficient, however, and a thick scum formed, followed by foaming. In order to stop the foam from overflowing through the manhole in the concrete roof, the operator was forced to lower the level by drawing sludge. This was done about every two weeks so that in a short time the tank contained only raw sludge which was in a highly acid condition.

To make matters worse, the scum built up to a depth of ten feet in July 1927 so that when raw sludge was pumped from the settling tank, scum flowed back through the overflow. As the scum was septic, large quantities floated and were carried over to the trickling filters and caused clogging of the nozzles and of the filter stones.

To remedy these conditions, the overflow was first diverted to a sand-bed, then all the scum was pumped from the digestion tank by means of a diaphragm pump. Lime was added to raise the pH value to about 7.3 and a small amount of ripe sludge was added as "seed."

Under these conditions a fairly well digested sludge was obtained in less than three months and foaming troubles were eliminated. The scum layer was reduced to a thickness of about one foot. This scum was black in color and inoffensive. Even after the winter months this tank gave satisfactory results. The sludge is black, inoffensive and slightly alkaline. Due to the small tank capacity, it is probably not thoroughly digested.

STORM LAKE, IOWA

The design of the Storm Lake digester is similar to that at Antigo. This tank was put into operation in July 1927. During the first few weeks there was very little action. Lime was then added, and vigorous gas evolution followed. Only a very thin scum layer was present. This consisted almost entirely of grease. A 4″ pipe is connected to the gas dome so that this scum can be drawn off if necessary.

The tank is equipped with two coils of 1¼″ pipe for sludge heating. A complete heating and gas collection system has not as yet been installed, so the gas at present is allowed to escape to the atmosphere.

SIOUX FALLS, S. DAK.

The Sioux Falls plant was started up in August, 1927. This plant has three digesters. The gas vents consist of two rectangular openings in the concrete roof along the tank diameters. Each of these is 1′9″ wide by 40′ long. The gas collects under sets of inverted metal troughs set in these openings and flows up to separate seal gas domes which are at the highest point. There are eight domes to each tank.

A system of piping connecting the digesters and clarifiers allows flexible operation so that sludge may be pumped from either of two clarifiers to any digester. Sludge may also be circulated from bottom to top of the digesters or from one tank to either of the others.

At the start, raw sewage was run in by gravity up to the normal water level in the clarifiers. Since then only sludge has been pumped. The tanks were being used in rotation, i. e., each tank was receiving raw sludge one day and resting during the next two days. Lime was added to adjust the reaction to pH 7.3.

No troubles were experienced until the following spring, about a month after the packing house sludge started to come in. Then, foaming occurred, undoubtedly because of this heavy load of raw material. Good digestion had not yet been established because of the low winter temperature, so that very little ripe sludge was present. As the temperature rose, the accumulated sludge and packing house sludge began to gassify and rise to the surface.

Lime was added to control these foaming conditions, but although it gave temporary relief, usually the next day the scum started to rise. Recirculation of the bottom sludge seemed to give better results. The foaming was finally controlled by a combination of liming and sludge circulation after the level in the tanks had been lowered about six inches to prevent the foam from flowing out through the gas troughs.

The gas collection troughs are not entirely satisfactory because when gas accumulates under them, one end usually tilts up and allows the gas to escape. They also allow scum to accumulate over them.

SUMMARY AND CONCLUSIONS

The operation of seven separate sludge digestion tanks has been observed over a period of two years.

The present effective capacities of the units at these plants vary considerably in relation to the amount of solids received per day. This appears to be the best basis of comparison and of design, as it considers the strength of sewage and suspended solids removal by the settling units. Total per capita capacities do not take these factors into consideration nor do they consider the fact that sludge cannot be stored up to the overflow line.

Tests showed that trouble was experienced at all the plants started at the beginning of cold weather

where there were no ripe sludge or heating facilities available.

Although reaction adjustment with lime to pH 7.3-7.6 proved beneficial in several instances, it caused foaming in a tank containing a large quantity of acid sludge which had been allowed to accumulate during cold weather. Where such conditions exist, it is advisable to empty the tank of solids at the beginning of warm weather and then start it anew, adjusting the reaction at the start. This will require less lime and prevent formation of a thick alkaline sludge at the bottom of the tank.

Reaction adjustment under these favorable temperature conditions will reduce the probability of foaming because it hastens the digestion process and causes a more rapid formation of ripe sludge, the presence of which in sufficient quantities prevents foaming.

Lime additions have little effect on a tank containing sufficient ripe sludge, because this material prevents a drop in pH value by the acids produced from the raw sludge due to its high buffer action.

Frequent additions of small quantities of lime is much better than adding large amounts at one time. Care should be taken so that overliming in the bottom sludge does not occur. This can be checked up by making pH value determinations at various depths in a tank.

Addition of lime to a foaming tank affords only temporary relief and may even lead to more serious foaming troubles, as lime will hasten digestion and cause more gas to be liberated. The best remedy is to pump out all the scum and then adjust the reaction. Circulation of ripe sludge from the bottom to top of the tank is also beneficial.

The thick scum layer characteristic of practically all plain digestion units is cut down to a minimum by a slow stirring mechanism. This is due primarily to the release of the entrained gas in the scum.

All the tanks described are now functioning in a satisfactory manner. The Antigo plant continues to give best results due to the maintenance of a high sludge temperature throughout the year by means of a heating system.

Acknowledgement: The plants discussed were designed by the following:—Hartford, Kiel and Antigo, by Jerry Donohue Engineering Co., Sheboygan, Wis.; Sheboygan by A. L. Boley, Ass't City Engineer, Sheboygan; Ridgewood by E. J. Fort, former village engineer, Ridgewood; Storm Lake by Currie Engineering Co., Webster City, Iowa; and Sioux Falls by A. Chenoweth, consulting engineer, Sioux Falls.

The writer is indebted to these engineers, the city officials and operators at the various plants, and to the Dorr Company, for their valuable assistance in this work, which was done under the direction of Dr. Rudolfs, in connection with the Sewage Research Fellowship at Rutgers University.

Remarkable Reduction in Water Waste

Caney, Kans., has recently been investigating the heavy water consumption, with the result that the monthly pumpage has been reduced from 13,000,000 gallons to about 5,000,000 gallons. One leak was wasting 40,000 gallons a day. Checking up and repairing meters resulted in a decided increase in revenue, which, with the reduction of 60 percent in the pumpage, makes the result of the investigation decidedly worth while. W. W. Barr is superintendent of water.

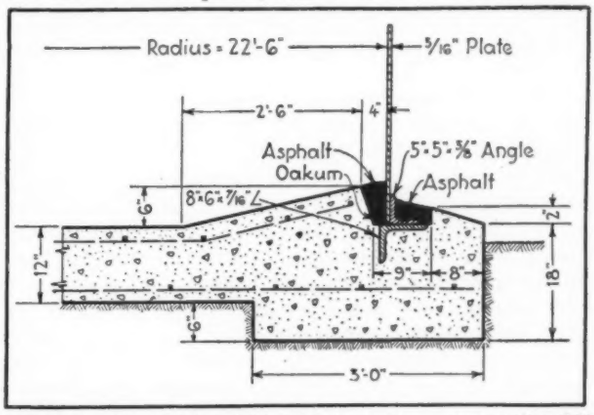
Some Water Tank Details

Steel tank with concrete bottom, on rock and sand subsoil. Another with steel bottom on base of asphalt penetration macadam

In an article before the California Section of the American Water Works Association, I. E. Flaa describes some interesting details of tanks built in connection with the San Francisco water supply. At present there are in San Francisco fourteen tanks, besides seven distributing reservoirs; four of the tanks being of steel or iron, one of reinforced concrete, and the remainder of wood.

The latest of the steel tanks was built in 1927 and differs from the other three in that it has no steel bottom, but the concrete base itself is used as a bottom. It was built to take the place of a smaller wooden tank, which had become inadequate. Permission had to be obtained from the Zoning Commission to build the tank, which was granted after a promise to make the tank ornamental in design, and to plant trees and shrubs around it after erection to make it still more pleasing to the eye. The Spring Valley Water Company had on hand previous to the earthquake in 1906, plates for building a tank forty-five feet in diameter and forty feet high which it was about to construct, but this tank had not been constructed and the plates were still in the warehouse. They were used in building this new tank, but this was made only twenty-five feet high, the remaining plates being retained for the later construction of another tank when needed.

This tank was so constructed as to rest upon the concrete base in such manner that the cylindrical shell is free to move on the base within certain limits. There were three reasons for this; (1), in the event of another earthquake, there will be less chance of



DETAIL OF JOINT BETWEEN SIDE AND BOTTOM OF TANK

the lower seams becoming ruptured; (2), to take care of expansion and contraction when the tank is empty, which might stress the joints, causing leaks; (3), it is a known fact that the bottom of a steel tank deteriorates more rapidly than the shell.

The concrete base twelve inches thick is reinforced top and bottom with half-inch square bars both ways at eighteen-inch centers; the outer edge of the slab for three feet was made about eighteen inches thick, principally to insure a good foundation under the place of greatest load. A water-tight joint between shell and base was obtained by constructing a depression in the concrete, in which was imbedded an 8x6x7/16 inch angle, on which rested the angle riveted to the bottom of the shell. The inside of the depression was first caulked with oakum and then filled with an asphalt filler known by the trade name of "Biturine Joint Mastic." The outside of the depression also was filled with the same material, to keep the water from coming in contact with the two angles where they join and cause rusting. A full load test proved that the joint was absolutely tight.

During the excavation for the base, a layer of loose sand was encounterd, which sloped downhill and intersected the base excavation in approximately the middle of the foundation. In order to avoid the possibility of this loose sand flowing from under the foundation, it was all removed and replaced with solid concrete of a lean mix; thus, in effect, one-half of the base is resting on solid rock and one-half on concrete.

The utmost care was taken in mixing the concrete for the base slab to make it dense and water-tight. The mix was designed to give a minimum of two thousand pounds per square inch concrete, and tests taken show an average of about 2,300 pounds per square inch.

The conical roof is of wood frame and sheeting, covered with variegated colored asbestos shingles. It is supported by five 8-inch I-beam columns on the inside of the tank, which rest on concrete bases cast on the bottom slab, and are free to move on their base. The columns are braced to the side of the steel shell and to each other. The roof is ornamented with a galvanized iron cornice, which is also a ventilator and is surmounted with an ornamental galvanized ventilator in the center.

The plates were painted with one coat of red lead, after they had been rolled and punched and before they were delivered at the site. After erection another coat of red lead was placed on both the inside and outside, and the outside was then given a green finishing coat.

Mr. Flaa also described briefly another tank 95 feet in diameter and 30 feet high, built by the Marin Municipal Water District, which is built in the customary manner with a steel bottom, but the base is somewhat unusual. The site was excavated down to the proper grade, than a layer of clay of a minimum of three inches thick, with a five-inch crown in the center, was wet and rolled. On top of this was placed a two-inch layer of No. 4 rock, which was then thoroughly sprayed with No.2 road oil on which was placed rock dust or screenings. This was then rolled to a hard finish. Over this was placed about two inches of sand, on which the tank rests, the bottom being first painted with Bitumastic Enamel before lowering on to the sand. Drains at the toe of the cut lead away all water from the adjoining hillside, keeping the foundation dry.

The San Jose Water Company erected two 50,000-gallon steel tanks 22 feet in diameter and 18 feet high, with steel bottom, which are set on reinforced concrete eight inches thick, on which was placed two inches of sand which was saturated with road oil.

Kansas Water Ratings

The State Board of Health of Kansas annually prepares and publishes ratings of the surface water supplies of the state. The report for 1927, recently made public by James L. Barron, assistant engineer of the state board, shows that a general improvement was made in 1927 over the records for 1926 in the matter of ratings.

The ratings of the various cities are compared on the basis of the product of the total number of weekly samples of water submitted to the state boards for analysis during the year by the sum of the percentage of them which are classed as excellent and the percentage which are classed as good. Samples are supposed to be sent in weekly and, if all of them are either excellent or good, the rating number would be 5200, which is the maximum obtainable. Mr. Barron states that "a dividing line of 4500 is probably as good as any, below which the sensitive water superintendent will find little comfort, and above which he can feel that sterilization, at least, has been largely satisfactory." The 1927 figures show 31 cities as having a rating above 4500 as compared with only 26 the previous year; while records for the year 1919 (although ratings were not then being made) would indicate that not a single town would have been above the dividing point of 4500.

Last year 8 of the cities had records of 5200—that is, they submitted a sample every week and each of these was classed as either excellent or good. These cities were Erie, Osage, Coffeyville, Eureka, Oswego, Topeka, Olathe and Herington. However, Erie and in a lesser degree Oswego and Topeka are criticized because their samples were not regularly collected away from the treatment plant, the board having requested that samples be collected from taps in the distribution system.

Supplies secured from wells that require sterilization due to questionable location or the presence of contaminating organisms are listed separately from those having surface supplies, as it seemed unfair to cities treating surface waters to include in their competition supplies from wells or springs where the problem is one of bacterial destruction only. However, several of the well supplies are accomplishing excellent results in softening and iron removal which, of course, are not indicated in a rating based on bacteriological quality and the regularity with which samples are submitted.

Out of approximately 230 towns, only 50 had a clear record for 1927; that is, no samples which were not free of organisms of the coli-aerogenes group. In other words, at least one sample from each of the 180 municipal supplies was in questionable condition during the year. Many of the well supplies, on the other hand, have had clear

records for a number of years; Atwood for seven years, Cimarron and Mound Ridge for 5 years each, and a number of communities for 4 years.

The samples are classified as excellent, good, fair, doubtful and bad. Of the fifty-three surface water supplies, 2 per cent of the analyses were considered bad in three cities, 4 percent in two cities, 6 percent in two cities, 11 percent in one, 23 percent in one, 25 in one and 34 in one. Only two cities submitted no samples during the year which could be classed as excellent, and no cities failed to submit at least one sample which could be classed as good.

Conventional Symbol for Indication of Several Characteristics

By H. G. Menke*

Engineers, statisticians, and others often wish to depict on charts, graphs, or maps by a single symbol, a unit or condition which may possess many different characteristics. It is usually desired that such a symbol be small and compact to allow close spacing and still be clearly indicative of the data which it is intended to display.

The writer was confronted with such a problem some two years ago when he wished to display, on a blank map of the state, the location, type, treatment accorded the water, and the condition of the public water supplies in the State which were on record with the State Board of Health. He wanted a symbol which would be legible when the map was reduced to about one inch to fifty miles scale and also one which could be blue printed without having to resort to the labor of coloring the prints. It was also desirable that changes in characteristics of the plants could easily be made to show on the map without damaging the tracing, from which the prints are made, by numerous erasures.

Various geometric symbols were considered but could not be adapted to show sufficient different features and it was found that squares and triangles, hatched and crossed in different ways, were difficult to memorize long enough to refer to the legend.

Finally, the idea occurred to him of utilizing the face of a clock as a symbol and hands pointing to different hours to show the several characteristics. It was thought that the face of a clock, being familiar to everyone, would serve nicely and the idea proved practical. A map was made about 32 by 48 inches and photos taken on 5 by 8 inch paper.

The symbols showed up clearly and were easily read and remembered.

A glance at the symbol fixed the different hours firmly in mind and reference then to the legend gave the data.

Thinking that others might like to use such a symbol, the writer desires to give it publicity through technical literature. The cut will quickly convince anyone that the scheme is plainly legible and practical.

*Assistant sanitary engineer, Alabama State Board of Health.

Leakage Surveys in Maryland

Hagerstown, Maryland, has a distribution system containing about seventy-five miles of cast-iron pipe in sizes ranging from four-inch to twelve-inch. Most of the service pipes are of wrought iron galvanized. In 1922 the leakage seemed to increase to a very large amount, and the water commissioners entered into a contract for a complete survey of the system to cost $3,500. Although this cost seemed high, it was finally decided to accept it, and a complete survey of the system was made.

All valves were tested by opening and closing them, several being found to be closed entirely, several partly closed, several with leaking packing, and several with bent stems. All water meters

METHOD OF INDICATING LOCATION, TYPE, TREATMENT AND CONDITION OF PUBLIC WATER SUPPLIES

Note: This is a sample of method only, and does not show actual conditions

of two-inch size and over were tested for accuracy. A 12-inch cast-iron main which had been in service for fortytwo years was found to have no leakage, and another 16-inch pipe in service sixteen years also showed no leaks.

The survey revealed sixty-six leaks ranging in quantities from a service leak of 2,000 gallons a day to broken mains leaking as much as 150,000 gallons per day. One 6-inch main was found broken under a railroad track along a sewer, and a 4-inch main where it ran through a culvert under the street.

The survey occupied about three months and showed such a saving in water that the expenditure was considered more than justified. Leakage to the amount of nearly 600,000 gallons per day was found and repaired. With water costing ten cents per thousand gallons, this meant approximately $60 per day, or a total saving of the entire cost of the survey in less than three months.

This information was given by Albert Heard before the Second Annual Conference of the Maryland Water and Sewerage Association. In discussing this, E. J. Canton of Baltimore stated that in that city a survey had just been completed of a 30-inch line in which no leaks were found, but it was considered as having paid for itself by making it possible to put all the valves in good condition. Baltimore makes its own pitometer surveys.

Water Mains On Bridges

Method of supporting pipe. Provision for temperature changes of length and freezing. Air pockets in pipe

Construction of water mains on bridges was the subject of a paper before the Canadian Section of the American Water Works Association by G. G. Routledge, superintendent of water distribution of Toronto, Canada. He was of the opinion that water mains in such location, being subject to vibration and stresses greater than they would experience underground, should be of wrought iron or steel, with special attention given to their protection from rust and tuberculation.

The best methods of supporting the pipe vary considerably, depending chiefly upon the designs of the bridges which are to support them. In some cases brackets supporting the sidewalk provide convenient supports for the pipes, while in others, the pipes can be suspended with iron rods or bars from the floor beams or attached to other bridge members. It is advisable to have two supports for each length of pipe, so that, in the event of a failure at a joint, the pipe itself will be securely held in position.

For pipes on bridges, Toronto uses either the ordinary screw coupling joint, or joints with flanges, either screwed or welded onto the ends of the pipes and bolted together. The former have been found more difficult to make watertight, but when made watertight they have remained so and have the advantage over flanged joints that they offer no difficulties to the installation of insulating materials. Flanged joints permit a pipe being taken out of the line and replaced with another more easily, but in these days defects in the line would probably be repaired by welding the pipe in place.

The ordinary range of temperature of the water in such a pipe and therefore practically that of the pipe itself will rarely exceed 40° Fahrenheit, and the maximum change in a pipe length of twenty feet will be about 1-16th of an inch. The ordinary stuffing box type of expansion joint has been found satisfactory to provide for this expansion. The bridge itself, if of steel, will be subject to several times this range of temperature, which will result in movement at the points where the pipe is attached to the bridge, and possible disturbance of the insulating materials at these points. This can be avoided by making each pipe joint an expansion joint. On a bridge now under construction in Toronto, one-half of the 12-inch pipes will have Victaulic joints, which will permit of movement without leakage.

Practically no trouble has been experienced with joints of pipes on bridges, but there has been trouble with pipes and joints immediately outside of the bridge abutments, due to settlement of the fill. Lead joints in spigot and socket pipes have been found preferable to flanged joints at these locations, as they are more flexible. Clamps of half-round iron, driven into the face of the caulked lead and firmly tightened on the pipe with bolts and set screws, prevent the blowing of lead joints where a pipe is displaced permanently due to settlement of a fill or temporary displacement in some ground under heavy moving loads.

In most cases where a pipe is supported from a bridge, there will be a high point near the center of the bridge in which air will collect. The use of automatic air valves has proved troublesome, and such valves are difficult of access. Tests made in Toronto indicated that an average velocity in an 8-inch pipe of about 1.7 feet per second will remove the air from the pipe.

Where there are freezing temperatures and the possibility of low rate of flow through the pipe at the same time, it is necessary to encase the pipe with some insulating material. Even where the rate of flow ordinarily is higher than that required to prevent freezing, there may be periods of forced shutdown during low temperatures. Some pipes in Toronto are protected by encasing them in a square wooden box, constructed of 7/8" tongue and grooved pine flooring boards, of sufficient size to receive the flanges, which gives a minimum thickness of sawdust of about 3 inches on all sides. The sawdust must be kept dry, and to secure this the top of the box is covered with sheets of galvanized iron clinch-jointed together and dressed down the sides for a distance of about four inches.

The last three lines constructed in Toronto were protected as follows: (1) Surround the pipe and

fittings with heavy asphalt felt, secured with jute twine wound spirally with 3-inch facing. (2) Apply a coat of asphalt at a temperature of 212 degrees Fahrenheit. (3) Apply a layer of insulating felt 1 inch thick, secured with heavy jute twine wound tightly and spirally at 1½ inch spacing. This forms one complete layer, and is repeated in the same order and manner for as many other layers as are considered necessary. After the last coat of insulating felt has been applied, it is surrounded by heavy asphalt felt and coated with hot asphalt. A jacket of either metal or heavy asphalt roofing is then applied, sealed with an asphalt sealing compound, and secured with separate rings of pure copper wire, galvanized wire or galvanized metal straps spaced about four inches apart. The insulation should be continued through the abutment and for a short distance beyond. It is estimated that four layers, or a total thickness of 5 inches, is required to protect the pipe for six hours at 25° to 30° below zero, when there is no movement of water in the pipe. If there is a shutdown for more than six hours, the pipe should be dewatered.

During the discussion, E. M. Proctor stated that he had found that a six-inch water main with eight inches of gypsum around it would stand seventy hours at an outside temperature of 20° below zero, and with no flow of water. In the far north it is impracticable to place a main at a sufficient depth to be below freezing where the excavation is in rock. He had taken a 24-inch light pipe and put a cast iron pipe inside it, with insulation between the two composed of the gymsum material referred to, mixed like mortar and poured in the bottom part of the pipe first and the top part afterwards, and allowed to dry. The material must be kept dry and after the work is completed must be sealed up tight. The theory is that the latent heat is retained in the water and that it then does not freeze.

Water Main Joints on Bridges

Among the questions raised for discussion before the Second Annual Conference of the Maryland Water and Sewerage Association, was the one: "Does Leadite Stand Up under Conditions Where Vibration Occurs?"

R. B. Morse, chief engineer of the Washington Suburban Sanitary District, stated that they had laid an 8-inch lead-jointed main over a light bridge in which leakage became so bad that the joint had to be caulked once a week. Finally, four years ago, the joints were replaced with leadite and no trouble has been experienced since then. The bridge partially collapsed recently and the pipe was left suspended, but even then the joint did not break or leak. On another bridge, so light that every passing vehicle caused excessive vibration, a main was installed using leadite, and there has been no leakage from this.

J. M. Diven, Jr., stated that in Baltimore, leadite has been found to make tight joints on bridges. In Utica a 20-inch main crossed under eighteen to twenty railroad tracks; it was first laid with lead joints and gave a great deal of trouble, but later when some of these were uncov ered for repairing they were remade with leadite and no trouble has been experienced since then.

Filter Operation at Variable Rates

In a paper with the above title presented before the Iowa Section of the American Water Works Association by Harry N. Jenks, associate professor of sanitary engineering, Iowa State College, the author expressed the opinion that a rapid sand filter can withstand reasonable overloads, basing his opinion largely upon comprehensive data gained during a season of continual overloading at a 32 m.g.d. filtration plant at Sacramento, Calif. From a study of these data he drew the following conclusions:

1. Provided that overload rates are kept within proper limits, the operation of filters at variable rates of itself has no deleterious effect on the quality of the effluent, as compared with operation at a constant rate.
2. By varying the rate of filtration to correspond to the curve of water consumption, it may be possible, under favorable conditions, to reduce the size of storage reservoirs or elevated tanks, to an extent otherwise inadvisable.
3. Apparently, the length of filter runs that may be expected when filters are operated at overload rates, is equal to some constant divided by the product of the total loading (expressed as a given per cent of normal) and the duration of such loading. It is suggested that it would be of value to determine this constant for various types of water as treated in different plants throughout the country.
4. Filter runs are shortened to a much greater extent by the duration of overload rates of filtration than by the amount of such overloads.
5. As judged by the criterion of quality of filter effluent, the permissible duration of overloads decreases rapidly with increases in rates of filtration above normal.

Sewage Pumping in Hackensack*

Hackensack is sewered on the combined system, and the sewage is treated in two plants, a north side and a south side plant. The present disposal works and pumping equipment were installed in 1922. All the sewage goes to so-called "flotation basins," from which clear liquid passes to the river and the settled material and part of the liquid are pumped to grit chambers and Imhoff tanks.

There are two manually operated pumping stations and four automatic stations. Each of the manually operated stations contains two four-inch and two six-inch horizontal type pumps of the H. B. Wood design. They run twelve hours a day, and one has run 24 hours a day for six months and only stopped to renew packing. The four-inch pumps handle the settled sewage, street grit, etc., at a speed of 1,160 r. p. m. They are 10 h.p. and pump 450 gallons per minute. The suction lift at times exceeds 20 feet, and they discharge at all times through three-quarters of a mile of pipe. The six-inch pumps handle the excess flow of the preliminary treated sewage, discharging it to the river. The sewage in entering these basins passes through three-inch coarse screens. The basins are provided with hoppers, two to each basin, from which the pumps draw the settled material.

Of the four automatic stations, one is operated by two Wood 6-inch horiontal trash sewage pumps; and each of the other three stations has two 5-inch Wood trash pumps. This gives a total of 16 pumps of this design used in both the manually operated and the automatic stations.

There are no screens in any of the automatic stations, the pumps handling the raw sewage. There

*Abstract of paper by Wm. Kannegiser before New Jersey Sewage Works Association.

has been no clogging at any time, either with the manually operated pumps or with the automatic stations where no screens are employed. It is not unusual for the pumps to pass scrubbing brushes, rags, sticks of wood of various lengths, stones, etc. When the hoppers are cleaned out, the pumps are required to take the sediment, which contains all kinds of material and a great deal of sand.

Concrete Block Manholes

By T. A. Day

The obstruction of a street in which a sewer line is being laid is generally continued longer than it would otherwise be by the necessity of waiting for the construction of the manholes along the line. Anything which hastens the completion of the manholes will frequently also hasten the filling in of the trench and paving of the street.

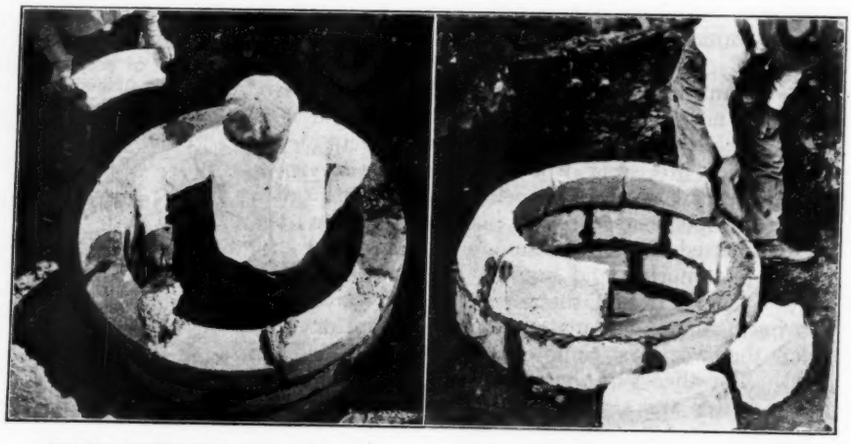
Municipalities in Illinois and in at least ten other states, to a total of considerably more than one hundred, have adopted the practice of building manholes with the use of radial concrete blocks. Sewer contractors in Chicago and vicinity have found that, on the average, concrete block sewer manholes can be built in one-third the time required to build with brick or monolithic concrete. A crew of one bricklayer and two common laborers with a little practice can lay up a concrete block manhole 48 inches inside diameter and 10 feet deep in three or four hours, whereas the same crew would require ten or twelve hours to build the same size structure of brick or other small units. This usually results in a saving of from $15 to $25 per manhole by the use of concrete block construction, there being a saving in the amount of mortar required as well as in the labor. The same construction is used for catch basins also.

The blocks are usually six inches thick and six or eight inches high. Ordinarily ten units of 24-inch radius are required to build one course of a manhole, having an inside diameter of 48 inches; nine of 21-inch radius for 42-inch manholes, eight of 18-inch radius, and seven of 15-inch radius. The units in each course are made rigidly interlocking by means of tongue-and-groove, or grooved ends. When laid, the former are "buttered" with mortar; while the core holes formed by adjacent ends of the latter are filled with soft cement mortar. Courses of either type are always laid in full beds of mortar.

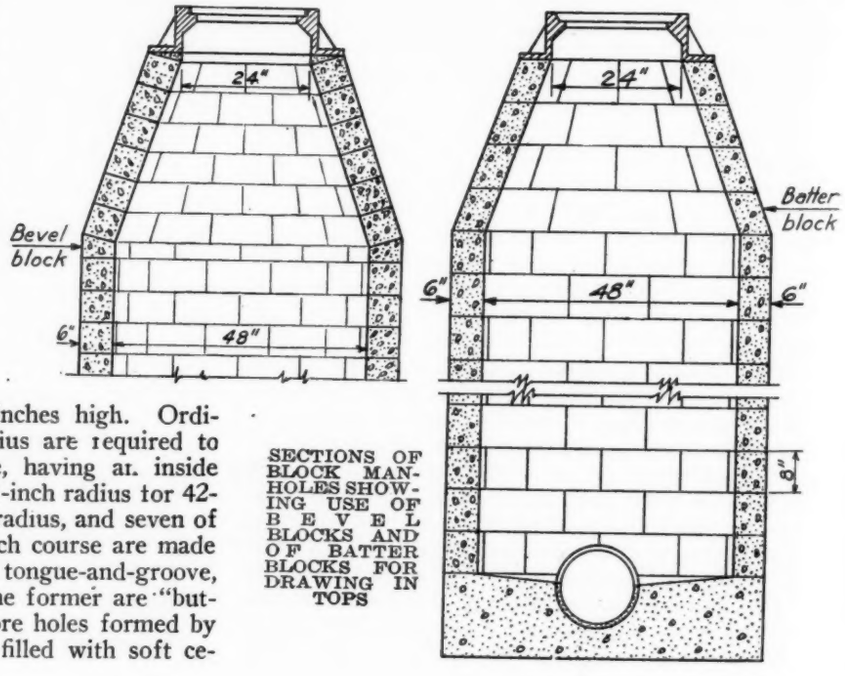
To draw in the tops of manholes to approximately a 24-inch diameter, two methods are in general use. The use of the batter block requires one ring to reduce a 30-inch structure to 24 inches, two courses reduce a 36-inch, three to reduce a 42-inch structure, and four to reduce a 48-inch structure to 24 inches. In the other method, one ring of beveled block is used to start the cone, which consists of standard block with one less block in each succeeding course. The top of the structure is then leveled up with a ring of stiff mortar, or by means of one course of reverse bevel block.

In providing openings for inlet or outlet pipes, units which arch around and over the pipe are frequently used; or by cutting standard blocks to fit. Inverts and bases are usually made of concrete.

This type of block has been used in more than sixty cities in Illinois and a number in California, Connecticut, Indiana, Iowa, Massachusetts, Missouri, South Dakota, Tennessee, and Wisconsin, and



USING GROOVED-END BLOCKS INTERLOCKING BATTER BLOCKS



SECTIONS OF BLOCK MANHOLES SHOWING USE OF BEVEL BLOCKS AND OF BATTER BLOCKS FOR DRAWING IN TOPS

in Vancouver, British Columbia. These concrete units are not patented and can be manufactured and used by anyone.

Standard City Surveys

Program for comprehensive engineering survey suggested for general use. Triangulation, traverse, levels, topographic and property surveys

"American cities need comprehensive engineering surveys as a basis for operation and planning. Since, generally speaking, fundamental conditions in all of them are very similar, it seems reasonable to assume that the survey program which proves satisfactory for one will serve with little modification for all." With the above introduction, Robert H. Randall, in a paper before a meeting of the Survey and Mapping Division of the American Society of Civil Engineers, proceeded to outline a program which he considered had been found satisfactory in a number of cities and was suggested as a standard.

"A consensus of actual practice indicates that the city survey comprises the following general divisions: (a) Triangulation; (b) Traverse; (c) Levels; (d) Topographic Map; (e) Property Map; and (f) Wall Map." In some cases the first three have been grouped together and termed a Geodetic Survey, while the Topographic Map and Wall Map were considered under the head of Topographic Survey. It was assumed by him that the fullest possible use would be made of the controling continental surveys of the United States Coast and Geodetic Survey, and the standard maps of the U. S. Geological Survey. Where these Federal surveys are not yet available, "every effort should be made to influence State authorities to cooperate with the Federal Government in financing their completion."

"The place of aerial mapping in the city survey schedule has been the subject of much controversy. As a comparatively new method, it has received much publicity and rather sweeping claims have been made for its results. Air maps have a distinct value in city planning and operation, but it is believed that this consists more in their use as exhibits or explanatory information than as substitutes for the surveys recommended in the foregoing schedule. They have the advantage or ready comprehension by laymen and of the presentation of a practically unlimited amount of detailed data." However, they are subject to perspective errors, which increase rapidly with the map scale until a point may be reached where so many ground locations are necessary that the added expense of air views is not justified. Where a map is made at the customary scale of either 200 feet or 400 feet to one inch, the air map will not ordinarily give results of as great accuracy for the same expenditure as is obtainable by ground methods. "Where scaling accuracy is not a requirement, or where small scales are used, air methods in many cases will give satisfactory results at less cost than ground surveys . . . Air maps are to be considered as adjuncts to, rather than substitutes for, any of the various divisions of the standard city survey."

The general divisions referred to are defined and discussed by Mr. Randall as follows:

TRIANGULATION.

In the execution of any survey extending over a large area, it is necessary to provide for the logical distribution of the small, unavoidable errors incident to any system of measurements. If it is attempted to join together small, individual surveys, each satisfactorily accurate in itself, it will be found that the small discrepancies between them will accumulate and give trouble and the greater the number of surveys and the farther the distance from a central point of origin, the greater the difficulty. It is essential to plan from the whole to the part, rather than from the part to the whole. For this purpose a system of controlling surveys of an accuracy superior to the smaller detailed surveys is first established. After its discrepancies have been determined and adjusted, it constitutes a basic framework to which all other surveys may be referred. For the City Survey two controlling systems are necessary, the horizontal and the vertical.

Triangulation constitutes the chief horizontal control. Basically, it is a series of overlapping triangles. After a certain number of triangle side lengths, or base lines, have been measured on the ground, the others become known by measurement of angles. For the control of metropolitan areas, distances between triangulation stations are determined with a precision of from 1 part in 50,000 to 1 part in 100,000.

The arrangement and distribution of triangulation stations necessarily vary with the conditions encountered. Ordinarily, an average of one station for every 1 to 3 sq. miles is satisfactory. All stations are monumented and referenced in as permanent a manner as possible.

TRAVERSE.

Traverse lines, executed with transit and tape, and with almost the same procedure as the measurements of triangulation base lines, are used to extend and to make more convenient the results of the triangulation. Traverses start from and close upon triangulation stations or upon previously adjusted traverses. They are run over streets or highways, and the stations thus established are carefully monumented and referenced.

Under some conditions the traverse itself constitutes the chief horizontal survey, without triangulation. Results of an accuracy averaging 1 part in 30,000, or better, may be expected from it.

LEVELS.

Levels are classified as first and second order in respect to accuracy, and constitute the vertical control system. Levels of the first order are run by the most precise methods; are then double-run, and the backward and forward runnings of each section must not have an error (in feet) greater than $\pm 0.17 \sqrt{M}$, in which M is the length of the section, in miles. Permanent monuments, or bench-marks, are established in pairs at proper intervals throughout the survey area. Levels are run in loops or circuits, and the closing errors of these are distributed by an adjustment according to the method of least squares. Leveling of the second order of accuracy originates with and closes upon the positions established by the first-order system. Its monuments may be less permanent in character, it is single-run, and is required to close within $\pm 0.05 \sqrt{M}$.

TOPOGRAPHIC SURVEY.

The topographic survey comprises the making and publication of topographic maps of the metropolitan area. The purpose of such mapping is too well understood to require emphasis. Briefly, it records and presents in the most business-like fashion all the essential information pertaining to the shape, elevation, and other physical characteristics of the land surface, and the properties, structures, and other improvements laid out on it. Such maps bring, for all practical purposes, the terrain itself to the engineer's or planner's desk. Their use eliminates all ordinary preliminary surveys and supplies most of the data needed for con-

struction plans. In addition to their value as the basis for designing improvement projects, the maps constitute an authoritative reference for all questions regarding land conditions that may arise in the conduct of the community's business. Properly executed, they form a permanent inventory of the two great physical considerations, land and its occupation, and constitute what is perhaps the best known division of the total City Survey.

Actual mapping is best done by the plane-table method, controlled, of course, by the co-ordinating positions of the preceding precise horizontal and vertical surveys. The maps of the important parts of the metropolitan area are on a scale of 1 in. = 200 ft. The individual sheet size is commonly about 20 by 25 in., the longer dimension being east and west For large areas the exact sheet limits are based on even multiples of seconds of latitude and longitude, usually 35″ or 40″ of latitude and 60″ of longitude. This is desirable because it permits a combination of plane and spherical projection, which tends to reduce the amount of variation from true azimuth incident to any considerable extension of a plane co-ordinate system.

The field sheets for plane-table mapping are mounted on metal, to insure retention of scaling accuracy despite changes in humidity. Each has plotted upon it, before it is taken into the field, all positions of triangulation and traverse, and all level elevations within its area. Using these data as a basis, the field party records, by plane-table and stadia methods, all details of topography and drainage; streets, alleys, and public property lines; railroads, bridges, tunnels, and retaining walls; public and industrially important buildings; dwelling-houses in unsubdivided territories; property and survey monuments; wooded areas; etc. The exact amount and detail of information desired necessarily vary somewhat in different instances.

After the map has been completed in the field, all the street and public property lines are carefully compared with all existing records, thus providing an additional check on the accuracy of the map. Formerly, after this checking was completed it was the practice to trace the penciled lines of the field sheet in inks of various colors before proceeding with publication. This step is now usually eliminated, and the reproduction of any number of copies is accomplished without changing the condition of the field sheet, thus leaving it in shape to be taken back to the field at any time for revisions or additions.

In order both to make a large number of copies available for use and to preserve the original field sheet from detetrioration through use, it is necessary to reproduce or publish copies of the topographic map sheets. This is now done chiefly by combined photo-lithographic and engraving processes. The final copies show topography, by means of contours, in brown; drainage, in blue; property lines, structures, and lettering, in black; and wooded areas and in some cases, public property, in green. It is essential that all the accuracy of the metal-mounted sheets be preserved in the press-plates from which final copies are printed. For this purpose large and precise camera equipment is necessary, and it is advisable that the boundaries controlling the plane-projection plotting of the field sheet be drawn on each sheet by a standard metal template by which the focusing marks on the ground glass are also established.

PROPERTY SURVEY.

This survey includes the preparation of all those maps which require the showing of figures and dimensions. For this reason the scale is usually about 50 ft. to the inch. The map sheets are usually laid out to conform to the topographic survey sheet system. Controlling and coordinating positions are furnished by the triangulation and traverse, and all other field work is accomplished by careful transit and tape traverses. The base maps thus constructed serve not only for property records, but for all other maps which require the showing of numerous details, such as those used for recording the positions of underground structures, construction plans for sewer and water improvements, etc.

Accurate and reliable property information is the basis of this survey, and the work of securing it may be considered as two separate steps. The first of these is the determination of the actual location, on the ground, of all street corners, angles, and curve points. The second step is the precise measurement and co-ordination of these points. It is sometimes the practice to employ an outside organization to execute the second, or precise survey step. The first, however, should be performed by the best informed local surveyors, who should possess more intimate and reliable information regarding the actual location of property lines than is possible to outsiders.

It is becoming increasingly the practice to begin the complete schedule of the City Survey by establishing controlling monuments in the outlying, or development, sections, for the purpose of tying-in new subdivisions. Under existing platting laws it is frequently possible to require new subdivisions not only to submit surveys of their own boundaries with prescribed accuracy and to monument street corners properly, but also to tie in to the controlling points established by the city. If this procedure is carried out, a complete and coordinated property map of the newer parts of the city will be built up without cost to the public beyond the establishment of the few controlling points and the necessary supervision required in co-ordinating the allotments with them.

WALL MAP.

The purpose of the wall map is to present a general view of the entire area. Its scale, therefore, will necessarily vary with the extent of the territory to be covered, since the map itself should be of a size suitable for desk or wall use. The wall map is compiled chiefly from the maps of the topographic survey, usually to a large extent by photographic reduction. Some copies should be made available showing all the colors of the standard topographic survey reproductions, and some should be prepared without the topography showing the black, or the black and blue, only.

Topographic Mapping of the United States

Desirability of completion of mapping the entire country, of which 57 percent remains unmapped

The Temple Act, passed in 1924, authorized the President of the United States to complete the topographic mapping of the country, using such agencies as he might designate. At the meeting this year of the Surveying and Mapping and the City Planning Divisions of the American Society of Civil Engineers, resolutions recommending to the Board of Direction of the Society that it consider the "very important question of the lack of fundamental elevations and geographic positions for the United States, with a view to making recommendations to the President of the United States in order that the data may be secured and made available within a reasonable number of years;" and that it be recommended to the President "that the entire cost of the fundamental triangulation and leveling systems be considered as national projects, to be paid for entirely from the Treasury of the United States," were adopted and later were approved by the Board of Direction of the Society.

As explaining the reason for the resolution, it was stated that in all major engineering operations, including city surveys and planning, highway development and extension, irrigation projects, hydro-electric development, improvement of rivers for navigation, flood control of rivers, and general topographic surveying and mapping, a knowledge of elevations and geographic positions is essential to their efficient and economic operation.

Topographic maps are needed in Federal investigations, in power projects and flood control projects, in soil surveys, for reclamation and irrigation proj-

ects, for locating roads, canals and so forth, for conservation and forestation, and for laying out aviation routes. It is stated as one instance, that a highway was proposed in Tennessee to connect two points fifteen miles apart, air-line distance. After the usual location surveys, a route was selected which was 26.3 miles long, with some heavy grades, and estimates for construction work computed. Before the work was begun, however, a topographic map of the region was made at a cost of $2,200. From this a route only nineteen miles long was selected, and one giving flatter grades and a saving of $200,000 in the estimated cost of construction.

Topographic maps require completion of a fundamental leveling and triangulation net over any section of the country involved, and at some time or other will be required over all parts of the United States. At present the country has only 43% of its area topographically mapped, and half the existing maps fail to meet present-day standards of accuracy. Control surveys in the form of triangulation and traverse for horizontal positions and leveling for elevations form an essential part of the topographic mapping of an area. They are the framework on which the detailed surveying is based, and are essential to the accuracy of the completed map. The fundamental first order triangulation and leveling has been done largely by the U. S. Coast and Geodetic Survey. Interstate projects of first and second order triangulation and leveling still remaining to be done amount to about 39,000 miles of triangulation and 70,000 miles of leveling.

To complete the topographic surveys for the unmapped 57% or the area of the country, to revise the maps already made which are obsolete, and to make the necessary and control surveys, will require only an amount equal to the cost of one battleship.

It is estimated that the field and office expense for mapping the areas not yet mapped, including the detailed third-order control surveys, would be $45,000,000. To revise the older topographic sheets made with inadequate accuracy, or with lack of sufficient detail, will require about $5,000,000. The interstate belts of first-order triangulation and lines of first-order levels will cost about $900,000, and the interstate first and second-order triangulation and levels will cost about $4,000,000, including both field and office expenses. The total cost, therefore, of making the control and topographic surveys necessary to complete the general utility map of the country, including the publication of the results, will be about $55,000,000.

Street Name Signs

In our April issue, under this title, we published an abstract of a pamphlet issued by the Municipal Administration Service, describing the results of some experiments made on the style and coloring of street name signs and their location on street corners. We have recently been informed by the Service that the city of Toledo has ordered 600 signs of the type recommended in this pamphlet, which will be installed in the down-town section of the city and at intersections in other parts of the city where traffic lights are located. They had estimated that each sign board constructed in accordance with this recommendation would cost about $5.00 and were very pleasantly surprised when they received a bid of $3.15.

We are also informed that W. T. Hunter, city engineer of Roanoke, Virginia, is giving the model sign a trial in that city, and that Mr. McCaffrey, one of the co-authors of the pamphlet, has received an inquiry from Russia which indicates that they are soon to be tried out there.

Autos vs. Airplanes in Persia

The absence of a passable road for automobiles between Teheran and Tabriz, Persia, resulted in the establishing last year by a German company of air service between these two cities, which continued throughout the year. Meantime, however, the road between these two cities had been made possible for passenger cars in good weather, the distance being covered in two days. As a result of this, the company found it unprofitable to continue the air service this year, and it has been discontinued. The bulk of the freight for Tabriz, however, still arrives by caravan or by the Russian railway, automotive transportation still being costly for any but the highest grade of merchandise.

It is certainly an interesting side light on the rapid development of commercial aeroplane service that regular service of this kind was established and continued in the Far East even before automobile service had been practically established.

Engineer's Part in Highway Safety*

Thirty percent of accidents in Indiana due to highway conditions, for which engineer is primarily responsible

"For discussion, the causes of accidents may be classified as follows: (1) Incidental to the operator himself, such as bad vision, sleepiness, dull sense, overwork, excessive speed, general disregard for traffic rules, etc.; (2) Defects in the automobile, such as imperfect brakes, obscured vision due to poor curtains or large corner posts, glaring or too weak headlights, broken connecting rod, etc.; (3) Highway conditions, such as sharp curves, steep grades, slippery surfaces, high crowns, narrow pavements or shoulders, steep ditch slopes, narrow bridges, holes in the surface, lack of super-elevation, railroad grade crossings, etc.

"The third class of accident is primarily a problem for the highway engineer. About 30% of all the accidents recorded in Indiana in 1926 were due to highway conditions. It would seem that such statistics would in a measure show the degree of responsibility to be taken by the engineer. While limited finances and other restrictions must of course assume

*Abstract of a paper by A. H. Hinkle, Chief Engineer of Maintenance, Indiana State Highway Commission, before the Highway Division of the American Society of Civil Engineers.

their share of responsibility for the engineer's acts, yet he must offer the proper advice to those to whom he reports. Hence, the engineer is primarily responsible for the proper design and upkeep of the highway, so as to reduce to a minimum the conditions that contribute to accidents. . . .His duty in the reduction of accidents is a very important one. Although the source of danger preventable by his work is limited, perhaps it can be more easily controlled than any other."

The author divides the conditions affecting accidents under the several headings of Curves, Grades, Combined Grades and Curves, Crowns, Width of Pavement and Road Shoulders, Sufficient Width of Right-of-Way, Slippery Pavement Surfaces, Ditches and Ditch Slopes Along the Highway, Railroad Crossings, Bridge Widths, Advertisements and Other Obstructions, and Warning Signs.

Curves. Under the heading of curves, he considers vision, horizontal curves, super-elevation, and widening on curves. As to vision, he states that a minimum clear sight of 500 feet between any two points five feet above the road surface seems to have been generally adopted for both horizontal and vertical curves. However, this may be affected by several conditions; for example, if a curve occurs at the end of a long tangent in open country, where high speed is normally invited, a short sight distance becomes far more dangerous than if it were closely bounded at either end by curves of lower degree which would normally slow down the speed of a vehicle.

In open country it is desirable to limit horizontal curves to five or six degrees; and to even less than this where practicable, to provide for the continuous increase in speed at which vehicles are traveling. In hilly country, however, where a driver is bound to be more cautions, curves as sharp as 20 degrees may be no more dangerous. The author suggests adopting the rule of making no curve more than six degrees sharper than a preceding curve ending within 200 feet of it.

He recommends that curves of two degrees or more be super-elevated in accordance with the formula $e = \frac{V^2}{15R}$, in which e is the super-elevation in feet per foot of width, V is the velocity in miles per hour, and R the radius of the curve in feet.

He also thinks it well to widen the pavement on all curves of five degrees or sharper, the widening being on the inside and the width in feet being about 0.3 times the sharpness of the curve in degrees.

Grades. From a safety point of view it is desirable to keep long grades down to three or four per cent. if no material additional cost is entailed. On main, heavily traveled highways, it is extremely desirable to limit long grades to five percent, even at considerable expense. On secondary roads seven per cent may be taken as a desirable maximum for long grades. For short distances, say up to 300 feet, seven per cent grades may not necessarily be dangerous on the main highways, nor nine per cent grades on secondary highways. A steep grade will be much less dangerous if approaching lighter grades and curves have slowed down the speed.

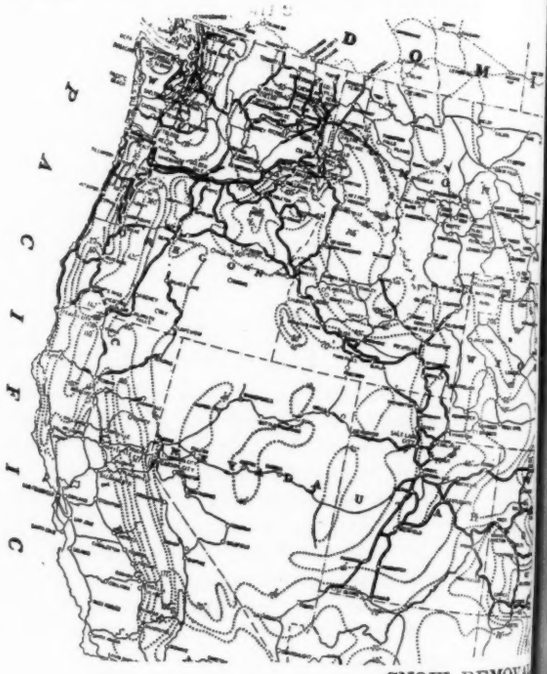
Combined Grades and Curves. The combination of the maximum curve and grade on the same stretch of road is sure to increase the hazard. It is difficult to determine what compensating value should be assigned to curvature in conjunction with maximum grade. Perhaps it is not far wrong to assume that five per cent of curvature may be equivalent to at least one per cent of grade. In a hilly or mountainous country it is well to guard against the mistake frequently made of securing long uniform grades at the expense of sharp curves.

Crown. High crowns are dangerous, especially where high speeds prevail. Perhaps the effect is almost negligible up to two inches of crown in 18 feet of width; however, on grades and curves, any camber increases the danger to traffic. Mr. Hinkle recommends omitting the crown altogether in some instances, such as in deep cuts, and carrying the water on the surface of the pavement itself instead of in the side ditch, the pavement being widened four to six feet and the shoulders narrowed when omitting the ditch. On a modern high-type pavement there seems to be little excuse for using more than 1½ inches of crown in 18 feet of width.

Width. The effect of width of pavement on safety is a matter open to argument, because the wider the pavement the higher the speed, and speed is a factor of danger. While some have claimed that a three-lane pavement is more dangerous than one of two lanes, data concerning accidents on an 18-foot and a 30-foot road leading out of Indianapolis appear to prove to the contrary.

Shoulders should be made six feet wide on 18-foot county pavements and eight feet on heavily traveled roads, both to permit turning on to them to avoid an accident, and also as a parking place for changing tires or other reasons.

Not only the road bed but also the right-of-way should be sufficiently wide, the latter to permit keeping telegraph poles and other obstructions as far as



SNOW REMOVAL
Heavy lines, roads included in removal program

possible from the traveled roadway. Sixty feet should be the minimum right-of-way for any important country road. Many states have the practice of securing eighty feet and even one hundred feet as a standard for their main state roads, but such widths are not practicable through rich agricultural lands, although commendable in sparsely settled, low-valued districts.

Slipperiness of road surface contributes to accidents and should be avoided in construction. Bituminous macadam or surface-treated roads can be made less slippery by using the proper grade and amount of bituminous treatment and of aggregate for covering. Concrete roads can be made less slippery by construction with a dry mix and proper finish. A sprinkling of cinders on a pavement which has been rendered slippery by oil dropped from motors is a great help.

Ditches. The slope of the ditch next to the road should not be made steeper than one on 3.5. This will allow automobiles which run into the ditch to come out again without upsetting. Also flat slopes are more economical to maintain because of lessened erosion, and reduced cost of moving grass and weeds.

Railroad Crossings. Discussing the matter of railroad crossings, Mr. Hinkle states that these should be made wide so as not to distract the driver's attention from the railroad itself. The road should not cross the railroad at an angle less than 25 degrees because of the danger that the wheels of a vehicle will catch in the groove alongside the rail. Center warning posts at grade crossings have been found to cause more accidents than they prevent. Finally, grade crossings should be eliminated whereever possible, more attention being paid to relocation to this end than has been in the past.

Bridge Widths. On all important roads, bridges of twenty foot span or less should carry the full width of the roadbed, including shoulders. With larger structures, because of the cost involved, some sacrifice may be necessary. On roads designed to carry two lanes of traffic, the proper widths for medium large structures are at least the width of the slabs needed to carry the traffic, plus eight feet for primary roads and four feet for secondary roads.

Advertisements. Any kind of billboard or obstruction along the highway which will distract the driver's attention is a contributing factor to accidents.

Warning Signs. Warning should be given of all danger points by means of signs which will be immediately recognized by the driver. The standard system for this purpose adopted by the American Association of State Officials seems to work satisfactorily and should be adopted universally.

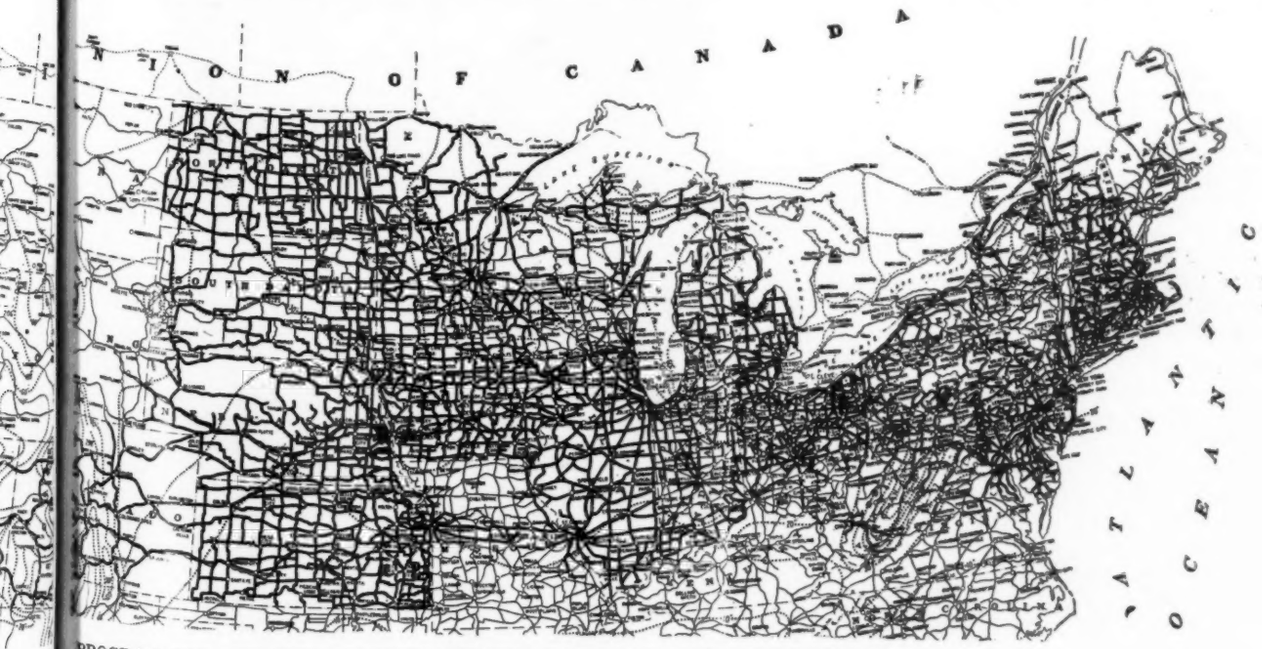
Widening Brick Streets in St. Petersburg

By using part of wide parking. Granite curbs moved back and old brick relaid

By York Briddell

Some twenty-four years ago St. Petersburg, Florida, a town of a few thousand inhabitants, decided to do some paving in order to get out of the deep sand. At that time the streets were laid out twenty to twenty-four feet in width. The town has grown until it is a city of many thousand people, and the city limits has spread to an area of forty-one square miles. As the city grew it has been necessary to widen the streets to take care of the increasing traffic. When the first brick streets were laid out, extremely wide parkways were left and it is due to this forethought that most of the beautiful trees and shrubbery have been saved.

*Supt. of the Georgia Engineering Company.



PROGRAM FOR 1927-1928 ON MAIN HIGHWAYS OPEN FOR WINTER TRAFFIC
Light lines, main highways not so included. Dotted lines, contours of average annual snowfall in inches

Granite curbing had been used and this required very little extra cost to reset to the new width of the street, and no loss of material was incurred except where the radius curb at alleys and street intersections was changed from 2½ and 5 feet radius to 9 feet at alleys and 15 feet at street intersections. However, the radius curbs which were replaced by new ones were not a loss, as they were used in driveways to private residences along the streets under construction.

The construction in connection with the widening of brick streets is very simple. The old brick in the streets are taken up and stacked back of the new curb line, and the new brick needed to fill in the additional width are stacked along with the old ones. The wear in the old brick is so slight as to make no difference when used with new material. A careful check up on measurements of the brick which has been down for seventeen years shows less than one-eighth inch wear on the wearing surface. The only brick requiring replacement from time to time are those broken in being taken up for sewer and water line work, and at the batting line some new brick are rquired to replace broken bats.

The method we used in widening brick streets here is very simple and I will describe same below.

METHOD OF CONSTRUCTION

After the old brick has been removed to a place back of the new curb line, stakes are set by the foreman in charge, to the required grade, which is given us by the City Engineering Department. We have on most of our widening work used five and six-inch gutter line, but the crown varies according to the new width of the street. The following table was used on this work:

20-feet widened to 30-feet—5-inch crown.

20-feet widened to 40-feet—5-inch crown.

20-feet widened to 50-feet—6-inch and 7-inch crown.

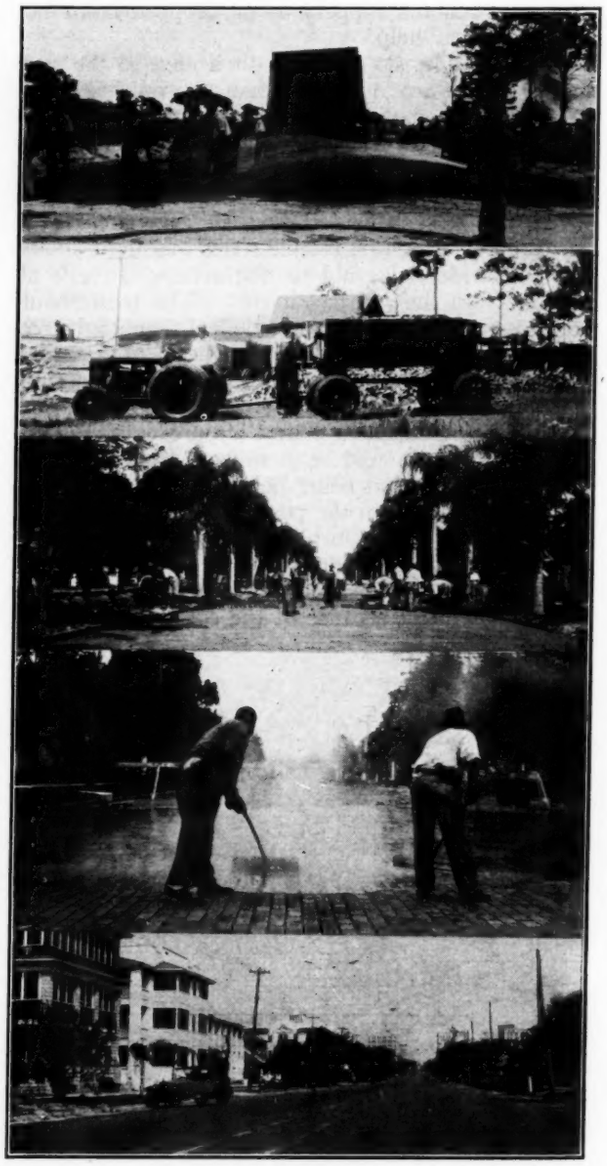
20-feet widened to 60 and 70-feet—7-inch and 9-inch crown.

The grading is next done, by hand labor in all cases. By using the hand labor method we were able to miss all house connections and other small pipe which a machine grader so often tears out. The subgrade being well ahead, it is flooded with water to compact same for rolling, which is done with a seven-ton tandem roller to compact the grade. Where any ditches or irregular places show up, these are filled with good material, and again the seven-ton roller is used on the grade. Next a lighter roller of 3½ tons is used to finish up and smooth the grade.

The grade being completed, the base is put on if specified in the contract. The base consists of six inches compacted oyster shell, spread and rolled in two layers. The first layer is put on and spread by hand, using what we call shell hooks. These are used in other parts of the country for spreading crushed rock or gravel. The spreading is followed up by a 3½-ton roller which levels the shell. Then a seven-ton roller is used and the first layer is rolled until thoroughly compacted. The second layer is put on and spread as before and rolled, except that the straight rolling is followed by angle rolling, which is done at an angle of 45 degrees each way. This compacts the shell, takes all kinks and uneven places out of the base and any depressions showing up are filled in with new material, and rolled again.

The shell base being finished, a sand cushion of one inch depth is spread on the base. This is pulled to a smooth and regular surface with a hand lute or template. The brick are then laid flat on this cushion in straight rows at right angles to the curb. The brick laying is followed up by inspection, and all defective brick removed from the pavement and replaced with good ones. Brick with corners broken off are turned over and if the other side is found good, the brick is allowed to remain, if not, it is thrown out and a good one put in its place.

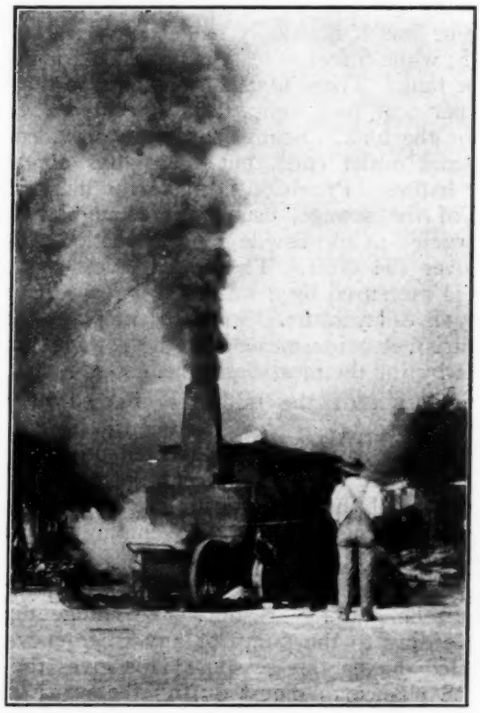
The pavement is now cleaned of all chips, etc., and rolling next takes place. This is done with a five-ton roller of tandem type. The pavement is rolled



WETTING GRADE AHEAD OF SHELL BASE AND SPREADING SHELL BASE
EQUIPMENT FOR HAULING MATERIALS
LAYING BRICK ON SHELL BASE WITH ASPHALT FILLER, WIDENING ROADWAY FROM 20 TO 32 FT.
USING SQUEEGEE FOR FILLER
ROADWAY WIDENED FROM 20 TO 40 FT. SAND FOUNDATION AND SAND FILLER

straight, starting at the crown of the street and working slowly toward one curb. Then the roller returns to the crown of the street and rolls in straight lines to the opposite curb in the same manner. After the straight rolling, angle rolling is started, working at an angle of 45 degrees from curb to curb. This takes the depressions and kinks out of the pavement and gives it a smooth surface. After the rolling, follows inspection for brick which have been broken by rolling. They are removed and replaced by good ones and tamped into place and surface.

If a sand filler is to be used, it is spread over the surface and swept into the cracks between brick until they are filled to the surface. The street is now opened to traffic. If the surface is to be filled with asphalt, the surface is cleaned as before. Kettles of asphalt are heated and the filler is drawn out into push carts, and rolled to the pavement ready to receive the filler. This is poured on slowly allowing the filler to go into the interstices and fill them up. A squeegee is drawn back and forth to work the asphalt into the cracks until a smooth surface is made. Where air pockets appear, they are filled with squirt cans. The surface is then finished with a light sanding, and the street is thrown open for traffic.



KETTLE HEATING ASPHALT FOR FILLER

REQUIREMENTS OF MATERIALS USED

The brick used were of standard size (3 x 4 x 3¼). A factory inspection of brick is required, including a rattler test. The brick shall not show a loss of over 26% after being submitted to the following test: Samples of brick of uniform shape and appearance shall be taken from each car tested (estimated at 10,000 brick) or from each kiln. Brick having a defect that would cull them shall not be used. Three grades of samples shall be tested; one of the softest, one of the medium and one of the hardest burned. If all of the tests over-run the specified percentage of loss, the car or kiln shall be rejected. If one or two of the tests over-run, another test of said grade or grades shall be made.

Should only one of the tests over-run the specified percentage of loss, the contractor may cull said grade provided they do not exceed 10% of the amount of the brick in car or kiln, and deliver the balance on the improvement. Otherwise the whole car or kiln will be rejected. Ten paving brick shall constitute the number to be used in a single test.

Asphalt filler shall be homogeneous, free from water, and shall not foam when heated to 200 deg. C. (392 deg. F.) The filler shall be heated to a temperature not exceeding 200 deg. C. (392 deg. F.) and applied at a temperature not less than 350 deg. F.

Shell shall be a clean oyster shell and contain not more than 20 percent by volume of loam, sand or other foreign material.

Brick has been found to be the most economical paving material used here, on account of the small loss in relaying. The cost of relaying the old brick was only 48 cents per square yard against new brick at $2.32 per square yard. By being able to relay the old brick with the new, the saving amounted to the difference between the price of relay and new material, which was $1.84 per square yard. Another saving was made in yardage where bricks had been laid on edge the first time and used flat the second time—approximately ten brick to the square yard.

A saving was also made by the use of granite curb the first time, as taking up and resetting it cost 15 cents per lineal foot against new curbing at 60 cents per lineal foot.

The widening work done here in the past four years has amounted to over 500,000 square yards, and the saving to the property owners in dollars and cents by the use of the old brick with the new brick was over a million dollars.

Up to January first, 1928, St. Petersburg had laid two hundred and eighty-four miles of paved streets, of which amount 213 miles is brick and 71 miles asphalt block.

All paving here is done by petition from the property owners. When they have two-thirds of the property feet signed up and have obtained the approval of the City Commission, they ask for bids on same. The entire cost, including engineering, legal and construction, is charged to the property owners. All intersections also are charged to them, the city assuming no part of the cost. The property owner has the option of paying cash or the ten year plan, paving certificates being issued bearing the legal 8% rate of interest. These can be paid in ten equai installments until taken up, if so desired.

American Road Building in Chile

An American firm has offered to construct roads for the Chilean Government in the northern zone of Chile, to be financed by the collection of a toll of one peso for each car or truck using the road, the offer including the reconstruction of existing roads and the building of new ones wherever desired. Should the offer be accepted, it is expected that there will be a greatly increased market for American automotive products and road building machinery.

Sewage Treatment on the Jersey North Shore

One-story tanks the standard. Pumping generally necessary. No sludge removed during bathing season. Frequent inspection by State Health Department

In a paper before the New Jersey Sewage Works Association entitled "Improvement to and Flexibility of Sewage Treatment Plants Along the North Jersey Shore," I. Russell Riker gave a general description of the plants which have been constructed during recent years in the seashore resorts of this section of that state. He begins by stating that "Every summer a million people more or less make their homes along the shore. Aside from this summer population, many millions visit the shore resorts on holidays or special excursions. The main features that attract these millions to our shore are surf bathing and clean environments. One can therefore see that the protection of our bathing beaches from sewage pollution is of great importance."

So far sewage treatment has been confined to sedimentation and discharging the tank effluent about a thousand feet from low water mark in about twelve-foot depth of water. Up to 1913, nineteen plants had been constructed, more or less crudely and with little consideration to future growth. They were usually too wide for the length, the ratio being 1 to 1 or 1 to 2, were so baffled as to prevent satisfactory sedimentation, were frequently below low tide level, and were generally inaccessible.

Of late years there has been a great improvement in the designing and construction of these plants, and it is these improved plants which Mr. Riker describes. The State Department of Health has had little difficulty in persuading the various communities to provide suitable purification plants when it has pointed out to them that not only the safety but the attractiveness of their bathing beaches depended on such treatment. Last year seven new sewage treatment plants were constructed along the ocean front and plans for three others were approved by the Department of Health.

The type of sedimentation tank adopted for municipalities in this district is practically standardized. No two-story tanks have been constructed, only one-story ones. One important consideration in designing a tank is that the summer population is about five times the winter, and it has been known to rise as high as twenty times the winter population. The summer season begins about the middle of June and extends to the middle of September, although of late years it has been extended to the first of June and the end of September.

Owing the the flat topography, it has been found necessary to provide pumping in most cases to obtain satisfactory operation of a plant. The State Department requires that the water level in the settling tanks shall be above high tide. Where it is necessary to pump raw sewage, the pumping equipment is designed for the maximum summer flow, and to discharge the sewage at the same rate at which it enters the wet well.

The capacity of the plant is designed for a population ten years in the future. An auxiliary source of power is provided, such as a separate unit consisting of pump and gasoline engine or electric generator operated by gasoline or oil. Raw sewage is usually screened, even with the latest type of open impeller sewage pumps. The pumping stations are usually made attractive. Very often a comfort station is made a part of the pumping station. With such an installation, the operator of the pump and sewage plant can look after the comfort station. An electrical warning device, which warns of the pump's breakdown, is installed in some public building.

More than one tank is always provided, both to permit cleaning of tanks or to provide for a breakdown, and also because of the wide difference in population between the summer and winter. The tanks are designed to provide for a total detention period of eight hours, exclusive of sludge capacity. Two cubic feet per capita is allowed for sludge capacity. The ratio of width to length depends upon the number of tanks; where the number is three or less it is usually made between 1 to 3 and 1 to 5; while 6 feet at least is provided for the depth of the tank. There is usually a slope in the bottom of 2 per cent. to a sump, usually located at the inlet end of the tank. Scum boards are provided at the inlet and outlet ends, but few tanks contain any other baffles. Provision is made for measuring the flow of the sewage, usually a rectangular weir so constructed as to provide end contraction and a free fall over the crest. The water level back of the weir is measured by a water level recording device, using an 8-day chart. Some recent plans include a Venturi meter for measuring the sewage flow, and this is by far the most desirable.

Ventilation of the tanks is effected by use of flagpoles about 75 feet high consisting of metal pipes which have been constructed adjacent to the tanks, to carry off the odors and gases and disperse them at such a height as not to cause any annoyance. Sometimes it is necessary to employ forced ventilation.

No sludge is discharged from the settling tanks during the bathing season. The sludge discharge pipe leading to the pump or any emergency outfall is sealed during this season. This gives the sludge a good chance to digest during the warm summer months. Tanks are cleaned usually in the late winter or early spring, at times of high tide, by forcing the sludge out through the outfall, usually by the same pump that pumps the sewage. Some of the sludge finds its way back on to the beach, but succeeding high tides wash it away. This method of sludge disposal was established by custom a number of years ago and the department has received practically no complaint against it and has therefore acquiesced in it. As the municipalities become more like all-the-year-round resorts, and as the populations grows, there is a question how long this practice will be considered satisfactory. Plans have been submitted and carried out providing for a sludge bed located on the roof of the settling tank and covered by glass, and it is the author's opinion that this will be the future means of sludge disposal along the shore.

Mr. Riker also believed that it would not be many years before chlorination of the settling tank effluent will be necessary and chlorine detention tanks are already being designed providing for a half-hour detention period.

For the outfall pipe, "universal" cast iron pipe or wrought iron sewer pipe is the most popular. The pipe is usually protected by piling to a point beyond the undertow.

These plants are inspected by the Bureau of Engineering of the State Department of Health at least once a year and some of them several times during the summer. Every plant is provided with an operator licensed by the State Department of Health, who reports each month the following information: Sewage flow; flushing sewer system; cleaning coarse screens; number of settling tanks in service; depth of sludge and scum in various tanks; when tank was cleaned, amount of solids removed and where and how disposed of; complaints as to odors; bypassing; test of the outfall by dye; condition of outfall; and appearance of the effluent.

Analyses by the State Board indicate that the new type of settling tank removes 60 per cent. of the suspended matter. There is no evidence of objectionable sewage suspended matter along the shore, and suspended matter or dye discharged through the outfall is dispersed within a few hundred feet of the outlet.

Treatment of Beet Sugar Wastes

Digestion in ponds in Germany. In England, precipitation with lime, septic tanks, contact and trickling filters and activated sludge

The most objectionable effluents from beet sugar factories are those which contain large amounts of dissolved organic matter, notably the diffusion and pulp press waste waters, which also contain 0.15 to 0.3% of sugar. The most successful method developed in Germany for treatment of these wastes involves successive fermentations of them in settling ponds, lime being added after each fermentation to neutralize the acid formed. The ponds are made narrow and deep in order to maintain high temperatures, which are favorable to the fermentation. The formation of a thick foam also aids in the process. The sludge is pumped to special fields, where it provides a fertile soil for plants. The liquid effluent may be discharged directly into a large stream, but frequently is passed to irrigation fields. In one instance cited, the reduction in nitrogen is stated to have been from 102 to 14 p. p. m.

From "Public Health Engineering Abstracts," abstract by H. W. Streeter of article in "The Surveyor."

"The waste disposal problems which confront so many industries present particular difficulties and burdens to the beet sugar industry. The manufacture of beet sugar being limited to about three months of the year throws a heavier charge on the cost of production for a given capital expenditure than is the case in industries which are employed throughout the year. This consideration assumes especial importance in view of the large quantities of water used and waste produced in the manufacture of beet sugar.

"The location of beet sugar factories in agricultural districts and on streams of comparative purity renders any contamination of the stream more noticeable and more significant than that which is caused by factories situated in industrial areas in the neighborhood of streams which have already reached a high degree of pollution."

"During the early part of the period for which the sugar factory is working, the flow of many streams is low and this may require greater storage facilities for the effluent or a higher degree of purity. The lower temperatures at this time of the year also affect adversely the activity of bacteria and the efficiency of biological methods of purification. In extreme cases, where a stream is frozen over, further difficulties are introduced since it has been shown that in such cases the dissolved oxygen content of an unpolluted stream may fall to as low as 40% of saturation."

Four different wastes are produced by beet sugar factories. Beet carrying and washing water, amounting to about 2 m. g. d. per 1,000 tons of beets treated daily, is the least objectionable, containing some suspended mineral matter and ordinarily but 20 to 50 p. p. m. sugar, and having an oxygen consumed value of about 340 p. p. m. This is treated successfully by plain sedimentation for 6 to 8 hours, and by precipitation with lime.

Diffuser battery and pulp press waters, together amounting to 300,000 g. p. d. per 1,000 tons of beets, are more objectionable and more difficult to treat. Combined, these carry 0.6 to 0.8% of sugar and an equal amount of other organic matter. Among methods used with some success in treating these are: Addition of lime followed by carbonation, with or without the mixing in of beet carrying and washing water; plain sedimentation and land irrigation; septic tanks with or without the use of lime; contact beds; trickling filters; fermentation with or without lime to neutralize the butyric acid formed; and activated sludge. Each process has definite limitations.

Filter press lime sludge is readily disposed of by application to land, preferably treated previously with quicklime.

Steffens waste water, the production of which is limited to the United States, is quite objectionable, having an oxygen consuming power of 3,000 p. p. m. and containing all the mineral salts of the beets which may be toxic to fish.—*From "Public Health Engineering Abstracts, abstract by D. E. Kepner of article in "Industrial Chemist and Chemical Manufacturer (London).*

Activate Sludge Plant for Salem

Plans have been approved for a sewage treatment plant for Salem, Ohio, which include pre-sedimentation; aeration by air diffusion, with tanks designed for spiral flow; and separate sludge digestion of the combined fresh sludge from the pre-sedimentation tanks and excess activated sludge. The plant was designed by F. S. Barckhoff, city engineer, assisted by C. C. Hommon, biologist and chemist.

Recent Developments in English Sewerage and Water Supply

The annual report for the year 1927 of the Ministry of Health of England contains a number of interesting statements concerning recent developments in water supply, sewerage and sewage treatment in Great Britain.

The consumption of water for domestic purposes in England has grown considerably in recent years and is still growing. The increase would be more marked than it is were it not for the increasing and more effective efforts that are being made to prevent the waste of water. It is due not only to the increase in population but also to change in habits and the demand for modern conveniences and improved sanitation. The conversion of privies and pail closets to water closets and the provision of hot water supplies in private dwelling houses has led to the use of much more water. Another cause of the increased consumption has been the restrictions on the use of preservatives of food, which has led to the extensive use of refrigerators, a number of those used depending for their working on a supply of running water, which appears to amount to at least one hundred gallons for a medium size house, and in some cases much more.

Because of this increase in consumption it has been found necessary to find additional sources of supply, and many cities are turning to rivers. Up to comparatively recent times most of the water supplies in England were obtained from springs and ground water. The report states that "The water as taken from the lower courses of rivers is generally unfit for domestic use, and the acts referred to [special acts of Parliament permitting designated cities to take water from rivers] contain provisions requiring the undertakers to treat the water before distribution so as to render it quite safe for domestic consumption. . . . There can be little doubt that recourse to the use of river water has been encouraged by the success, both as regards purification and finance, which has attended the methods employed by the Metropolitan Water Board for treating the water from the river Thames."

In the report it is stated that "twenty-eight months' experience has now been gained of the results of working a slow sand filter at about three times the normal rate, the water having been filtered previously through rapid filters working at the rate of about ·134 gallons per sq. ft. per hour. The results taken as a whole have been most satisfactory."

In the matter of sewerage perhaps the most important development has been the tendency to sewer areas on the basis of topographical rather than political boundaries. In a number of cases this has been attained by combining several systems so as to treat the sewage from all of them at a common plant, in most cases thus doing away with several small individual plants. As an example, the Seaton Burn Valley Joint Sewerage Board now administers the disposal, by trunk sewers discharging into the sea, of the sewage from the whole or part of five urban districts in Northumberland. This arrangement has made possible the abandonment of seven existing disposal works, all more or less inadequate or inefficient. Another instance is that of the Borough of Ilford and the urban district of Barking Town, whose growing population has necessitated increased facilities for sewage treatment. An arrangement has been made by which the sewage from the borough and the urban district will be taken to the existing disposal works of London County Council at Barking Creek. A different plan is illustrated by the urban districts of Calverley, Farsley and Gildersome, which have arranged with the corporation of Leeds whereby the sewage from the three districts will be discharged into the sewers of Leeds and treated at the disposal works of that city, thus permitting the abandonment of the three disposal plants of the urban districts.

Chlorination as Substitute for Cross-Connection Elimination

Last June a letter was sent to water supply authorities of New York State, calling attention to an extension of time granted by the Public Health Council for the elimination of cross-connections. The letter also mentioned the possibility of allowing chlorination of auxiliary supplies in some cases where it is impracticable to sever cross-connections between a portable water supply and a polluted auxiliary source.

A circular outlining the conditions which must be met in such cases has been prepared by the New York State Department of Health. The essential requirements are as follows:

The water supply must not be so grossly polluted that it cannot be effectively chlorinated.

The fire pump must either take suction from an open well or pump or there must be a municipal water supply available having a pressure at least three times as great as the pressure of the suction pump.

The water supplying the ejectors of the chlorinator must be from the municipality supply.

The chlorination equipment must be of a type approved by this Department and so equipped as continuously to waste a small amount of chlorine solution. It must be provided with solenoid or steam operated valves so regulated that immediately upon the starting of the pump it will apply chlorine at a rate of not less than twenty pounds of chlorine per million gallons of water pumped.

Platform scales must be provided for checking the loss of weight of chlorine.

Plans of the installation, together with report and sufficient data to pass upon it, must be submitted for approval both to the local water authorities and to the State Department of Health.

Reports of the results of daily orthotolidine tests of the chlorine solution wasted and the amount of chlorine wasted or used per day must be submitted at least monthly to the municipal water supply authorities.

Chlorinators on all auxiliary industrial or fire supplies must be inspected regularly and at frequent intervals by local water supply authorities.

The cross connection between a potable municipal supply and a chlorinated auxiliary industrial or fire supply must be equipped with double check valves of the "all bronze" type placed in an accessible chamber and properly equipped for testing and inspection. Such check valves must be inspected and tested at least monthly and taken apart, at least yearly, thoroughly cleaned and any worn parts replaced.

Discharge valves on the fire pumps must be closed whenever the pumps are turned over for testing.

Any approval by the municipal and water supply authorities or this Department will be given only on condition that the chlorination apparatus is satisfactorily installed, operated and maintained at all times.

Recent Progress in Road Oiling

Work done last year in Oregon, California, and other western states. Methods and costs in California

By Walter N. Frickstad*

The subject of bituminous oil treatment of fine crushed rock and gravel roads, with its promise of not only conserving material, but improving service to the public, has attracted such attention that it falls into discussion whenever a small group of western highway authorities gather together.

During 1927, Oregon, the western pioneer in the recent revival of interest in bituminous treatment, extended treatment of its highway system by 380 miles to a total of 950 miles. The surface method was used generally, but a series of experiment was undertaken as described hereafter. Oregon now has roads of this character more than four years old and has full confidence in their durability and usefulness.

The tendency in Oregon in 1927 was toward a heavy road oil for the second application, which involved a thicker covering of stone chips and brought less complaint from the traveling public concerning damage to automobiles driving through fresh oil. It is difficult to appraise the merits of these modifications until the end of next summer. The prophecy is ventured that the roads will not be as smooth as when treated with light oil exclusively, but the amount of repairing may be substantially reduced.

California in 1927 treated approximately 600 miles of road. Both methods, surface treatment and oil mixing, were used, apparently with equal confidence under the respective appropriate conditions. Some of the work was placed upon important highways and was frankly temporary in nature, but has been eminently successful.

California is now undertaking some oil plant mixing projects as described below.

Utah and Nevada during 1927 were added to the states undertaking oil treatment, the former with 30 miles and the latter with 5 miles. The work was in excellent condition in the middle of the spring, and its behavior during 1928 will be observed with great interest.

Idaho, which had previously used the surface method, undertook oil mixing upon 70 miles. Reports to date show excellent results.

Wyoming "oil mixed" one long project with Wyoming asphaltic oil. The highway department, having had rather unsatisfactory experience with paraffin base oils, is preparing to observe the condition of the recently treated project during the summer before undertaking an extended program.

Colorado is putting in sixteen miles of the penetration type of oil road this year, while New Mexico already has laid twelve miles and has another stretch of ten miles under construction.

All of the other states in the western region have indicated an interest in the use of bituminous oils, and with one or two exceptions, are planning to begin or continue this type of work during 1928. Many county highway organizations and a few cities are also planning similar work.

The experimental work in Oregon alluded to above has to do with heavy road oil and heavy tar. Three types were tried, classify by the highway department as "skincoat," ¼-inch to ⅝-inch in thickness; "penetration," ½-inch to 1⅜ inches in thickness, and a "road mix," ¾-inch to 2½ inches. The two methods first listed are efforts to solve the old problem of applying a thin coat of heavy oil and stone chips to a previously constructed roadway.

The Oregon "penetration" is similar to methods applied with great success in Riverside and San Bernardino Counties on concrete, and sometimes upon gravel. Careful selection of material and the most expert, painstaking supervision and workmanship have been found necessary in these counties. It is one of the most difficult classes of oil treatment.

The third class of experiments in Oregon, designated as "road mix," differs from the work of the same name in California, in the use of clean crushed rock with fines removed and the use of heavy road oil (90-95%) or heavy gas tar. A prime coat is first applied to the base, the coarse aggregate is added, and the principal application of oil is spread. The rock and oil or tar are then mixed with a blade grader until the rock is well coated. The material is then spread and rolled, a seal coat supplied, a small quantity of fine chips spread, and the whole then rolled again. In some cases an additional application of oil with more stone chips has been added. The result resembles penetration macadam, but the methods are quite different from those generally accepted. The blade mixing is not different in principle, however, from the harrowing which was commonly done in California between applications of oil in the earlier days of that type of construction.

The cost of work like that in Oregon can only be estimated, as the experimental sections were too short to furnish reliable data. A report by the Oregon state highway department, which describes the work in detail, estimated the respective costs as follows:

Thickness, ⅜-inch skin coat, cost per square yard, 10 cents; ¾-inch mat, 20 cents; 1½-inch mat, 35 cents; 2¼-inch mat, 55 cents.

As before stated, California has recently specified and awarded contracts on what may well be called an "old plant mix wearing surface." The largest project of this character is 118 miles on the Coast Route between Santa Monica and Oxnard. The project now stands graded and the contract provides for laying a temporary surface 24 feet wide, part of which will be 4 inches thick, compacted measurement, all of fine crushed rock mixed with oil. The remainder will have 3 inches of oil-mixed material on a 3-inch fine crushed rock base. It is assumed that paving will be required shortly, and this described surface is purely for the purpose of carrying traffic while the earth is consolidating. The significant items of the contract are: 42,000 tons of fine crushed rock at $2.79 per ton; furnishing 8,000 barrels of medium grade fuel oil at $1.50 per barrel, and mixing 34,000 tons of surfacing material at 35 cents per ton. The contract prices are fairly balanced but are well below the engineer's estimate. For mixing

*Highway engineer, U. S. Bureau of Public Roads.

the material the engineer estimated 55 cents per ton, and bids ranged from 25 cents to 43 cents. The contract price for mixing only is approximately $1,000 per mile for a 24-foot roadway and 7 cents per square yard for 3-inch or 4-inch compacted thickness. Reduced to 2 inches of compacted thickness and 18-foot width, the prices would become 4 cents per square yard and $420 per mile. If the material were mixed on the road, the cost would range from one-third to two-thirds of the foregoing amount, and the spreading of the oil would add something more. It may, therefore, be said, if these prices are representative, that plant mixing costs $150 to $200 per mile more than road mixing for an 18-foot surface 2 inches thick. The uniformity of the plant mixture, a quality difficult to obtain under present field methods, may well justify that much extra cost.

The traffic on projects already treated varies so widely that there may be some confusion as to the appropriate field within which oil treatment should be used. Some projects are carrying several thousand vehicles per day. It is true that the width of surface on these projects is generally greater than the normal two-lane width, but it should be emphasized that treatment under such heavy traffic was undertaken as a temporary or emergency matter, usually to furnish service to the public during the period of consolidating fills.

One of the first projects treated by the mixing method was in the Imperial Valley, where the excessive traffic had destroyed much of the surface material. To add to the difficulties, the subgrade was in many places poorly drained. Oiling was undertaken to save what rock remained and to carry traffic until funds could be gathered for more substantial construction. The expected has happened in that an appreciable percentage has broken and the maintenance costs have been rather high. The state's course in this emergency is beyond criticism, but the case illustrates that oil treatment is not a magical process in lieu of satisfactory subgrade and adequate thickness of rock. Until the contrary is demonstrated by several years of observation, the normal field for oil treatment, aside from emergencies, is that heretofore held by fine crushed rock or gravel. Research has indicated that the limit of traffic for the economical construction and maintenance of fine crushed rock ranges from 300 to 600 vehicles per day, in arid or semi-arid territory, depending upon the character of the stone and binder, and perhaps runs as high as 1,000 vehicles per day for ideal material in humid territory. It would seem wise to apply the same limits to oil-treated roads for the present, remembering, however, that climatic influences are reversed.

On the other side of the story, what is the minimum traffic that justifies oil treatment? The answer depends upon the cost of the treatment as against the unit value of the untreated material destroyed by traffic; also upon the consideration we should give to purse and comfort of the vehicle operator. Is oiling justified when traffic reaches 100 vehicles per day, or should the figure be 250 or more? Should we undertake any new project without making provision for oil treatment? These questions need not be answered definitely until more roads carrying heavy traffic are treated, but thought must soon be given to the subject.

In deciding whether a given project is adequately installed for oiling, width of surface is one of the factors. It has been said that oiling should not be attempted upon a surface less than 18 feet or 20 feet in width. This is undoubtedly a good working rule.

Bituminous Road Treatment in Virginia

Virginia has about 1,800 miles of macadam roads and 800 miles of surface-treated sand-clay, soil and gravel roads. For the preservation of these, it is the practice of the Highway Department to periodically treat them with bituminous material. This year's program includes 855 miles of road to be treated, using over 2,000,000 gallons of bituminous material and about 120,000 tons of stone, gravel and slag covering chips.

The ordinary pressure distributor is used for applying bituminous materials, but on account of shortage and expense of local labor it has been necessary to develop several devices that are not in general use.

For removing dust from the roadway before applying the bitumen, a broom is attached to the front end of a Fordson tractor, while on the rear end is mounted a blowing device by which dust and small particles which cannot be swept from the road are blown away. This is of particular advantage on roads that have not been treated previously.

Several types of chip spreaders have been developed, the most successful being a hopper attachment for the rear end of a hoist-body truck, with a disc which is driven by a small ground wheel. The spreader having been attached to the rear of a truck, and this having been raised so that the chips will flow into the distributor, the truck backs over the job, following immediately behind the tar distributor. By properly regulating the flow of gravel through a gate at the end of the truck, and the speed of the truck, the material can be applied very evenly at any desired rate.

Belt conveyors also are used very extensively for handling the covering material. It is estimated that by the use of belt conveyors and chip spreaders, the cost of the work has been reduced from one-third to one-half of that by the old hand method. The department also uses the ordinary road drags for distributing chips to the low places.

Sewage Pumping with Bedford Refuse

At Bedford, England, the refuse destructor was built adjacent to the sewage pumping station, and enough steam is generated by the former to pump all the screened sewage—about 1,600,000 gallons a day—against a head of 65 feet to the sewage treatment works.

A by-product of sewage screenings mixed with destructor flue dust is sold as fertilizer.

About 9,000 tons of liquid sludge and humus per year is spread on arable land for two or three years, after which the land is rented for farming for three years.

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A. PRESCOTT FOLWELL, Editor
W. A. HARDENBERGH, Associate Editor

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The Problem of the Mississippi

Probably no other engineering problem has received as much attention in technical and popular publications during the past year and a half as has the control of the Mississippi River. This is proper, not only from the viewpoint of its importance to the prosperity and welfare of a large section of the nation, but also as an engineering problem. In the next ten years there will be expended more than $300,000,000 on construction works designed to hold the river under control.

In this issue is outlined briefly and simply the general plan of the work, which was adopted by a special board created to consider the plans submitted by the Mississippi River Commission and the Chief of Engineers, respectively, the plan of the latter being the one approved. It provides for handling the maximum flood which the Weather Bureau considers possible to occur. It is based upon the idea that more channel cross-section must be provided to carry the flood waters of the Mississippi, and that the additional cross-section area should be provided horizontally, not vertically.

Aside from the interest created by the problem, engineers will find much of value in a careful study of the plan and of the methods adopted to put it into effect. PUBLIC WORKS has arranged for a series of articles describing the work being done in carrying out this plan, which will be published from time to time and will keep our readers in close touch with the work.

Fall Preparation for Spring Thaws

Most roads in the northern states are in their worst condition of the year during and immediately following the spring thaws. Three general causes of this are the presence of snow upon the roadbeds during the winter, which tends to concentrate wheel wear and load of all vehicles within narrow limits; the fact that during the winter the roads cannot be worked to advantage, whether they be hard-surface roads or earth, gravel, etc.; and third, the effect of freezing and thawing.

The removal of snow from highways has made great progress in the past few years, and the desirability of keeping the entire paved roadway clean of snow is well understood. More attention, however, needs to be paid in most states to the matter of providing outlets for the water flowing upon the roadbed, either that from rainfalls or that from the thawing of snow during warm spells or in spring. Provision should be made at all low spots in the road for carrying the water through the snow banks into the ditches, and away from the ditches to some final outlet.

As to maintaining gravel, earth and similar roads during the winter season, little can be done along this line if the surface is frozen hard. Freezing, of course, involves the presence of moisture, and if the roadbed can be kept practically dry it is still possible

to do sufficient work upon it to prevent pot holes and ruts from acquiring any considerable depth.

However, if a roadbed is wet throughout the winter, ruts, pot holes and other depressions are sure to form under traffic unless there be a continuous top crust frozen to a sufficient depth to hold up the traffic. In the spring, however, no matter how thick this crust may have been, when it thaws out the practical destruction of the road is almost certain.

Damage from the spring thaw can be avoided or at least minimized by providing adequate drainage by means of clear and sufficiently deep side drains, and by keeping the surface crowned and free from ruts and pot holes which would hold surface water; in other words, by continuously withdrawing any ground water and surface water from the road, so as to keep it comparatively dry for a depth of at least two feet below the surface.

Little can be done toward preparing the road surface and opening up ditches, etc. in the spring before the thaw occurs, but such work should be done in the fall before freezing begins and snow falls. Prevention of the spring breakup depends upon work done during the previous fall.

Ditches should be put into shape as to both depth and grade, and weeds and all other obstructions to flow removed. Culverts should be cleaned and made adequate for carrying the maximum volume of flow which will reach them during the spring freshets. Not only the roadbed itself but also the shoulders should be trued up and given a slight slope so as to shed all surface water to the ditches. No water should be allowed to stand in the ditches, soaking into the subgrade, at any time during the winter.

In the case of hard-surface roads, such as concrete or asphalt, cold weather tends to open up cracks and joints and these admit surface water to the subgrade. It is therefore desirable to see that all such breaks in the continuity of the surface be filled with a good bituminous filler during cold weather, while the joints are at their widest.

Winter destruction of roads is caused chiefly by freezing, and freezing involves the presence of water. Every precaution must therefore be taken to keep water as far as possible from the sides of the road as well as from its surface. It has become generally recognized that the best way to fight snow is to begin fighting while it is yet falling. The best way to fight water and frost is to complete the fighting before they arrive.

Road Accident Surveys

In a paper abstracted elsewhere in this issue, A. H. Hinkle has outlined the features of highway engineering which may contribute to accident hazards, thus calling attention to the engineer's share in the responsibility for highway accidents. John A. Mac Donald, highway commissioner of Connecticut, is making a careful study to determine just what responsibility engineering, as applied to the highways of that state, has to shoulder in connection with accidents which have actually occurred. A study has been made of the accidents which occurred in 1927, and a special investigation will be made of all points outside of cities where two or more accidents occurred. The highway will be surveyed and carefully examined at these points to determine to what extent and in what way road conditions contributed to the accident, and an effort made to determine how the conditions at these particular points can be remedied, and how similar conditions can be avoided elsewhere.

The result of this survey will be read with interest by commissioners of other states. However, they should do more than this—they should themselves conduct similar investigations. For many of the causes of accidents will be found to vary considerably from state to state. There are differences of climate; of grades; of surfaces, cross-section width and slope of the roadways; bridge widths; methods of maintenance, and many other details. The nature of the traffic itself may be an important factor in determining the hazard of certain features of design; such as the proportion of pleasure to business traffic, the relative number of heavy trucks and of motor buses, and the effectiveness of regulation of the traffic by traffic police.

In view of the thousands of lives lost every year through road accidents, the subject is one which deserves the most careful and diligent attention of highway commissioners.

Contracts to Other Than Lowest Bidders

Recent action of the New Jersey Highway Commission in awarding a contract to a firm not the lowest bidder was criticised in a Trenton newspaper as follows:

> Following the precedent recently established by the State House Commission in awarding a contract to a concern which was not the low bidder, the State Highway Commission gave to a company, on its bid of $466,886, a contract for building a road which another company had offered to construct for $450,449, which would have saved to the State more than $16,000.
>
> This action was taken on the advice of Engineer Sloane, who urged that the second company had not had sufficient experience and did not own a properly equipped plant. There is, of course, such a thing possible as enlarging a paving plant, and how is a paving company to obtain experience if it is to be "frozen out" of the bidding when it happens to underbid more influential bidders?
>
> There are bonding companies to protect the State against loss and to insure the completion of the work according to the plans and specifications, and the Highway Department employs inspectors to see that the plans and specifications are strictly followed. Under the circumstances it would appear that a company which can furnish a bond from a reputable bonding company should be given an opportunity to gain "sufficient experience."

A bond can be secured by almost any would-be contractor; equipment is obtainable, even without much money to pay for it; but experience can be gained only through long service. We do not know the circumstances or either of the firms concerned, but engineers and other public works officials are familiar with the vicious results that have attended the awarding of contracts indiscriminately to the lowest bidders. A nominal saving of 3½ per cent. may well prove an actual loss if offset by poor workmanship and months of delay resulting from inexperience, inadequate plant and law suits with contractor and bonding company, which the closest inspection and infinite patience and tact of the commission may not be able to avoid.

The New Jersey Highway Commission is to be congratulated upon their courage. Continuance of the practice with intelligent judgment will save the State money either directly or through securing better work.

Mississippi River Flood Control

General description of the Jadwin plan, adopted and now being acted upon, for controlling the maximum possible flow of the river by diverting excessive flood waters into lateral floodways and stabilizing the present channel.

Following the great flood of 1927 in the Mississippi valley there was a nation-wide demand for control works that would prevent the recurrence of such a catastrophe. Plans were presented by the Mississippi River Commission, and by the Chief of Engineers. The former is a semi-independent body, of which three members, including the president, are detailed from the Corps of Engineers. The two plans presented differed in a number of points and a board was created, consisting of Major General Edgar Jadwin, Chief of Engineers, Brig. Gen. Thomas H. Jackson, president of the Mississippi River Commission, and Carleton W. Sturdevant, civil engineer, civilian member of the board. The original plan of the Mississippi River Commission had been prepared under the direction of the late Col. Charles L. Potter, then its president.

The board studied the two plans, traversed the area and held public hearings at various points. As a result of this study, the plan proposed by the Chief of Engineers was adopted.

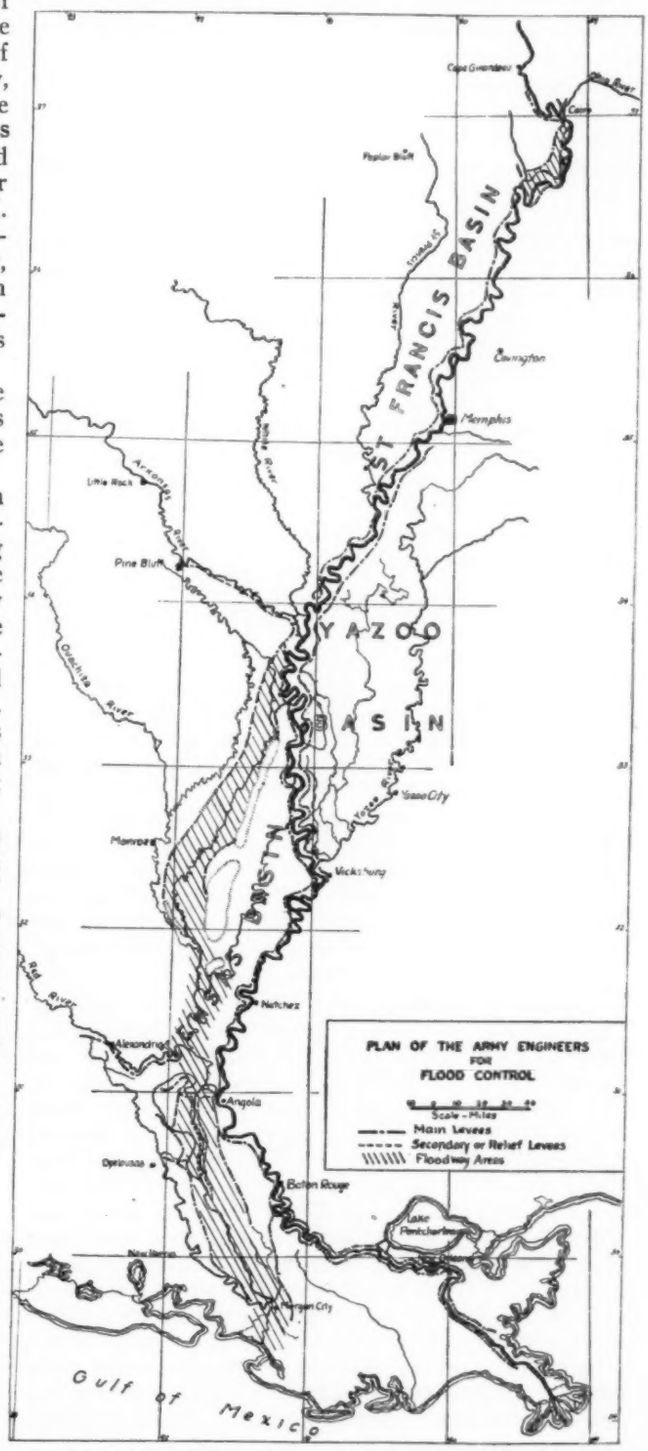
General Outline of Plan.—This plan is based upon the idea of limiting the amount of flood water carried in the main river to its safe capacity. sending the surplus water through lateral floodways. The essential features of the plan include a spillway above New Orleans, diversion floodways in the Atchafalaya and Tensas Basins, a river bank floodway from Cairo, Illinois to New Madrid, Mo., and a strengthening and moderate raising of the levees. The estimated cost of the flood control works is $185,400,000. Channel stabilizaiton and navigation improvement recommended are estimated to cost $111,000,000 additional, a total of $296,400,000.

Volume of Flow.—The amount of water which is designed to be handed by this plan is that predicted by the Weather Bureau as the "maximum possible." This was obtained by using the maximum Ohio River flood with the Mississippi, Cumberland and Tennessee contributing their greatest flows at such time as to insure the greatest effect at Cairo. This gives a gage, with confined flood, of 66 feet at Cairo, which corresponds to a discharge of 2,250,000 to 2,400,000 second-feet. The 1927 flood rose to 56.5 on the Cairo gage, and had a crevasse not occurred, the gage would have been 58.5. Below the Red river, the predicted "maximum possible" flow is 3,000,000 second-feet.

PLAN OF CONTROL

The alluvial valley of the Mississippi may be considered in three principal sections; The northern, comprising the St. Francis Basin on the west side of the river; the middle, reaching from the Arkansas south to the Red River; and the southern, from the Red River to the Gulf.

Northern Section.—From Cape Girardeau, the northern limit of the alluvial valley, to Cairo, protection will be accomplished by raising the levees from zero at the upper end to 2 feet at Bird's Point. The Cairo city levees are to be strengthened and raised to a height equivalent to 60 feet on the gage.



ARMY ENGINEERS' PLAN FOR FLOOD CONTROL OF THE MISSISSIPPI RIVER

The serious problem begins at Cairo. From Cairo to New Madrid, the main levee on the west bank constricts the river unduly and will be set back about 5 miles, which will lower the head at Cairo 6 feet in extreme flood. The land between the present levee, which will be lowered 5 feet, and the new levee 5 miles away from the river, will be protected and capable of cultivation at all times excepting in floods greater than that of 1922. The increased width available for flood water will, it is estimated, reduce the stages of a flood equal to that of 1927 so that the Cairo levees will have a 3-foot freeboard.

From New Madrid south to the mouth of the Arkansas, levees will be raised to a grade sufficient to carry the maximum flood. Local setbacks will be made where the river is constricted, in order to provide the necessary cross-sections. The average increase in levee height will be 3½ feet. If a levee is threatened with erosion, there is the alternative of abandoning it and building another further back. or of protecting the bank and stabilizing the channel. As the volume and consequent cost of a levee varies approximately as the square of its height, in the case of these higher lines the latter alternative will be adopted as the more economical.

Middle Section.—From the mouth of the Arkansas to the Red River, extreme flood cannot be carried between the levees of the Mississippi without dangerous increase in the height. To take care of the 1927 flood, present levees would have to be raised 12 feet, while predicted possible floods would top these by 8 feet. The plan adopted is to raise the levees 3 feet, and divert from the main channel into the Boeuf River Basin surplus waters which cannot be carried betewen the levees. The entrance into the floodway, which is about 15 miles wide, will be closed by a "fuse-plug levee" at present grade. Thus this basin will be protected in all floods except the unusual ones such as may be expected to occur about once in 12 years, which will overtop the present levees. A flood of a magnitude somewhere between those of 1922 and 1927 will opn the fuse-plug levee and give access to the floodway. Levees on either side of the Boeuf River will localize the extent of the flood flow. This area is about 60% swamp and timber, and will be left uncleared. All water in excess of 1,950,000 second-feet will pass into this floodway.

Southern Section.—Below the Red River, levee setbacks will be made at critical places in the main river, but it is not considered that the river can carry more than 1,500,000 second-feet between its levees. It is therefore contemplated that flood waters in excess of this amount will be diverted into the Atchafalaya Basin. Levees along the Mississippi will be raised a maximum of 3 feet and relief levees will be established at the upper end of the Atchafalaya which will fail when the water overtops them. The Atchafalaya River is intended to carry 500,000 second feet between its levees; when this flow is exceeded, the levees along that river will be overtopped, and a wide strip of the basin will come into service as a floodway, but other levees will limit the spread of the flood waters. The capacity of the Atchafalaya Basin will total 1,500,000 second feet.

At Bonnet Carre, above New Orleans, a controlled spillway, emptying into a leveed floodway to Lake Ponchartran is to be constructed. This will be capable of discharging 250,000 second feet; the remaining 1,250,000 second feet in the river will pass New Orleans without exceeding a 20-foot gage at Carrollton. Past records indicate that this will have to be operated once in five years, for a period of one to three months during each flood. It was considered desirable to take the water above New Orleans, thereby reducing velocity in the river and lessening the danger of underwater scour and consequent caving.

SUGGESTED ALTERNATIVE PLANS

In the report of the Chief of Engineers, there are discussed a number of plans which have been suggested as offering solutions for the flood control problem. Some of these are of interest, and will be discussed briefly.

Dredging.—To hold the river safely between present levees, the maximum stage must be reduced 8 feet. To accomplish this by dredging the channel, provided it were possible to remove material at the same or a faster rate than it is deposited, would cost, it is estimated, $80,000,000 annually.

Side Channels.—Excavated side channels are very costly, silt up rapidly and require frequent clearing. Leveed side channels are used in the plan described. They are economically practical where the land need not be cleared, and where cultivated land is not entirely lost to use.

Setting Back Levees.—To move the levee line back on one side of the river one mile would reduce the river stage 1 foot. To accomplish the required 8-foot reduction in stage would require a setback of 6 miles. This would require all towns to locate far from low water navigation and would abandon to the river the most valuable part of the valley, the high bank of the river. New levees would be on lower land and would have to be higher. While setbacks are economical and desirable in a few places, the method is not feasible as a general remedy.

Straightening the Channel.—Cut-offs shorten the river, increase the velocity and lower the flood stage. But increased velocities cause excessive bank caving, which in turn causes the river to form new bends. Moreover, unless begun at the lower end of the river and continued upward, the value of increased velocity would be only local.

Forestry.—It is stated that ½ inch of rainfall is absorbed and retained by the mat of humus on forest land. The Forest Service has recommended the acquisition of 8,500,000 acres of land for reforestation in the Mississippi valley. The absorption and retention of ½ inch of rainfall on this area would reduce flood stages in the Mississippi River by only ½ an inch.

Levees Only.—To hold the maximum predicted flood, allowing for a 5-foot freeboard, present levees would have to be raised 12 feet at Cairo, 19 feet at Arkansas City, 12 feet at Angola, and 6 feet at New Orleans. Increasing levees to such heights would enormously increase hazards from possible crevasses and involves many foundation difficulties.

Reservoirs.—From 7,000,000 to 11,000,000 acre-feet of storage—depending upon the location—are required to reduce gage heights one foot at Arkan-

sas City. Studies were made of available reservoir sites. It was found that 203 reservoirs, costing $1,300,000,000, and operated primarily for Mississippi River control, would produce a dependable reduction of 6 feet at Cairo and 7 feet at the mouth of the Arkansas. A system of 30 reservoirs not more than five days' flow from the Mississippi was also studied. Eleven reservoirs on the White and Arkansas Rivers, with a capacity of 37,000,000 acre feet, would have reduced the 1927 stage 8 feet at Arkansas City; but the cost of these is estimated at $240,000,000, and this system would not reduce the maximum predicted flood to a point where it could be handled by the present levees.

Creosoting Structural Timber

Untreated timbers in damp climates, or any situations where moisture can accumulate, decay more rapidly at points where they are in contact with each other or with other material, because at these points moisture accummulates and is retained, thus creating a condition exceedingly conducive to decay. It is therefore especially important that structural timber be thoroughly protected against decay at points of contact, and also at bolt holes or other places where they are in contact with other structural parts. As creosoting or other treatment to prevent decay usually penetrates for a comparatively short distance from the surface of the wood, scarfing or otherwise removing of the surface of timbers where they are to come into contact with others is inviting decay at the points where it is most likely to attack timbers.

To avoid this, it is desirable to frame all of the timbers going into a structure, including the boring of bolt holes, etc., before the treating of the same.

An illustration of this is offered by a water tank built at North Vancouver to replace one which in ten years had decayed to such an extent as to be in danger of collapsing. This 30,000-gallon tank was built of creosoted Douglas fir. Both the timbers and the staves of the tank were treated by the boiling-under-vacuum empty-cell pressure process with a final retention of 8 pounds of coal tar creosote per cubic foot. The foundation timbers were framed, bored, assembled and match marked before treatment. The materials was then reassembled after treatment according to the markings and the structure erected without further boring or cutting which would expose untreated timber and permit entrance of decay.

Factors in Design of Distribution Systems

Abstract of a paper before New England Water Works Association by V. Bernard Siems* and D. Benton Bisert† describing method of calculating capacities of different sections of a water distribution system.

The authors first considered the general factor of first cost, which, they stated, sometimes is given too much weight by the financiers or others furnishing the funds. Although "sometimes in the case of local private companies and small municipalities, the ultimate benefit to be realized from model design is disregarded for the more immediate charm of low first cost, the true economic design (which is also the proper physical design of a distribution system) depends upon technical factors which are fundamental and hence unchanged, except relatively, by the consideration of cost as a major factor."

Three elementary factors must be recognized in beginning the study of a system. The first is the practical objective of the contemplated water system,—whether a limited and restricted area is to be served, or whether the area has prospect of expanding; and if expansion is reasonably expected, in what manner and at what rate and in what direction such expansion will take place, and whether the developments will be industrial, residential, or a mixture of the two.

The second factor is the source of supply—its available capacity and suitability; whether gravity or pump; ultimate complete economic development, and probable utilization of additional available sources within the period of time considered as a basis for the estimates of future requirements.

A third elementary factor is concerned with the Metropolitan districting of the water supply utility. The relation which the system will bear to neighboring communities with or without public water supply, and the water supply district within whose boundaries it will be located.

While these are important in determining nature and suitability of the source, the total capacity and most advantageous position geographically of primary feeders, reservoirs, pumping stations and filter plants, there are other factors which more directly concern the distribution gridiron.

The authors refer to the January issue of the Journal of the American Water Works Ass'n., in which was a paper covering a study of distribution design by which future fire protection water requirements were made the basic principle of design. "The study embraced investigations to determine, first, the quantity of water used in combating fires of varying magnitudes in various types of buildings and characters of developments or neighborhoods; second, the factors altering those quantities; third, the relationship between those quantities and the quantities representing domestic consumption in the various characteristic neighborhoods of developments; fourth, the forecast of changing neighborhoods and the effective zoning restriction on neighborhood changes, future growth and characteristics; fifth, the economy of basing distribution system design upon future requirements; and sixth, a method of calculating the probable future maximum water re-

*Vice-president and chief engineer, Detwiler & Company.
†Assistant to water engineer, Baltimore, Md.

quirements." From this study the authors evolved a formula which expressed in equational form the fire protection requirements based upon the estimated future growth and characteristic developments of a community as a fundamental principle governing the design of a distribution system. This formula had as its factors the probable fire area involved in a serious fire in any neighborhood, the height of building, combustibility, the fire apparatus response, and a correction factor known as the "Baltimore equation" and developed by the writers to apply to the above a relative value for conflagration or exposure hazard.

"Observations of residential domestic water demand peaks have enabled the writers to work out a relationship between average daily, maximum daily and peak consumption and a comparison between peak domestic demand and fire protection water demand. It has been found that this relationship throws a new light on the subject of design fundamentals and hence has an important and direct bearing upon the principle of gridiron and distribution system design."

In applying this method and formula, while it was found to give reasonable results for large cities or business communities, where the major portion of the total consumption is consumed industrially or for commercial uses, it did not seem to be applicable to residential neighborhoods or small towns, where the day-to-day rates vary considerably and dry or hot weather peaks are reached that are quite incomparable to the average maximum consumption rate. In the latter the fire hazard is slight so far as serious fires are concerned, as the fire areas are small and fairly isolated. It was therefore found that insufficient capacity would be obtained if the fundamental of design was made the fire-protection water requirement. Statistics gathered to a period of five years indicate that for residential communities the maximum daily consumption is 1.5 times the average and the peak rate of draft is twice the average daily consumption. These are averages and individual cases may fall above or below them. The daily consumption in a given city will depend largely upon the rates charged for water consumed and whether or not the service supplies are metered.

The consumption per capita or per service several years hence may vary with the introduction of meters; raising or lowering of rates; change in racial characteristics of the consumers; introduction of sewerage, street washing or other developments, and for other reasons. But having estimated the future average daily consumption, the distribution system should be designed for a peak of double this.

For the large town, however, (except in the case of purely residential zones) or for industrial and transitional zones, the calculated features of fire protection water requirements should be chosen as the design fundamental.

It is important that the capacity of a system for fire protection be available as discharge from fire hydrants. There should be an adequate number of hydrants so located as to concentrate discharge quantities where needed. Having determined the quantity of water necessary for fire protection of a characteristic area, assume a discharge of 500 gallons a minute for each hydrant, and so determine the number of hydrants necessary. Then locate the hydrants symmetrically and according to system, placing them at intersections in order to receive the advantage of the support of the tie-in mains and also to facilitate quick location by fire fighting forces. They should be placed on alternate sides of the highway to divide the possible necessity of carrying hose across traffic.

Wherever it is impracticable to support long feeder or important transmission mains with lateral mains and gridirons, duplicate feeders should be provided. These looped feeders improve the capacity and efficiency of the system and likewise are a guarantee against interruption of supply and an aid to maintenance.

"In a community where a well regulated zoning law is practiced, the work of the designer of a distribution system is greatly simplified because he can more accurately foretell the type of future development of areas of population. Zoning therefore is a factor in that it reduces the degree of error in estimates of future possibilities, and hence is a guarantee against costly replacements and enlargements in later years.

"In proceeding with the mechanics of design, determine whether or not the community to be served will be predominantly residential at the termination of the period of time considered economic for the proposed investment. If the characteristics will be residential, calculate the average daily consumption, allowing 65 to 85 gallons daily per capita, depending upon whether the area is purely residential or residential with small minor mercantile centers, and basing population upon estimated rate of future growth. Multiply the average daily consumption so calculated by 2 to obtain the required capacity of the gridiron. Design feeder mains of a size sufficient to deliver the required quantity to the gridiron at a velocity not greater than the critical velocity. Design secondary grid of 6 and 8-inch mains where tie-ins are greater than 1,000 feet apart, and of 6-inch mains where secondary grid is closely tied in.

"If the characteristics will be commercial or industrial or mixed, the process to be followed is somewhat more complicated. In developments of these classes it becomes necessary to determine to what degree the development is commercial or industrial. As a business community is a relatively unstable one, inasmuch as it changes to a more congested class, reaching its limits of density in the high-value commercial district, a schedule to enable to the grading of such communities is here given and the various classes defined.

First Commercial: Transitional from residential representing a division of 60% to 40% residential. Typical store front dwellings and minor congested areas of business houses.

Average Commercial: Distinctly showing business preponderance, few dwellings, some apartments and flats over business houses. Congested smaller commercial and minor mercantile areas predominate.

Second Commercial: Congested pure commercial; large buildings.

High Value Commercial: Nucleus of the business section; highly congested; most dense property value; greatest fire hazard and exposure to conflagration.

Industrial: Individual plants grouped more or less closely; individual hazards may be high but exposure not so great because of areas of vacant land or of water.

"It is not good policy to assume an arbitrary demand for the purpose of determining the gridiron capacity for which to design; it is more accurate to calculate such individual problem. However, to generalize average demands based upon average developments, gridiron capacities required for the various zones of development described above are shown on Diagram 1. These capacities serve to indicate the maximums sufficient to adequately protect areas as defined above, assuming that the development of the area will have reached its limit. The minimum requirements are not fixed, in order that the reading of the capacity graph may be more flexible, i.e. that it may be more readily adapted to any area in any stage of development. That is to say, while what would be the average commercial zones in large and small towns are of the same relative importance to each community, yet structural conditions, fire hazards, and the relation of the fire protection water demand to tne general consumption demand would be incompatible; the calculated maximum capacity for the average commercial zone of the small town might not be so great as that for the list commercial zone of the large town. In fact, insofar as capacities are concerned, quantities greater than the maximum for 2d commercial may be disregarded when applying the capacity graph of Diagram 1 to small town conditions.

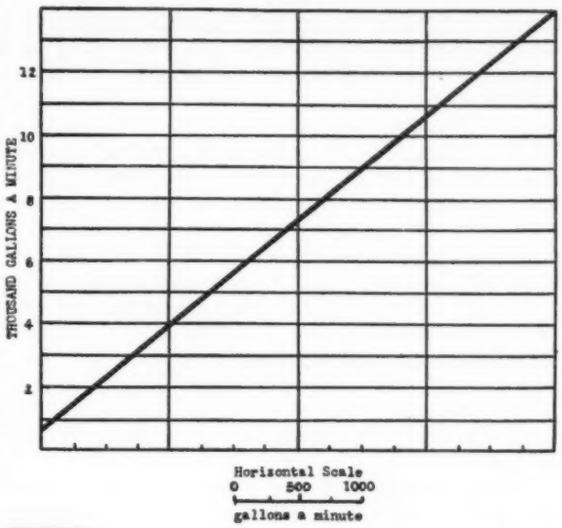


DIAGRAM 4—EXCESS CAPACITY FOR FIRE ENGINE PUMPS

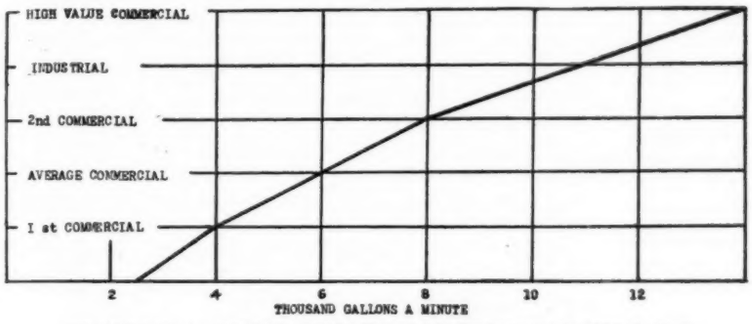


DIAGRAM 1—RECOMMENDED GRIDIRON CAPACITY FOR VARIOUS DEVELOPMENTS

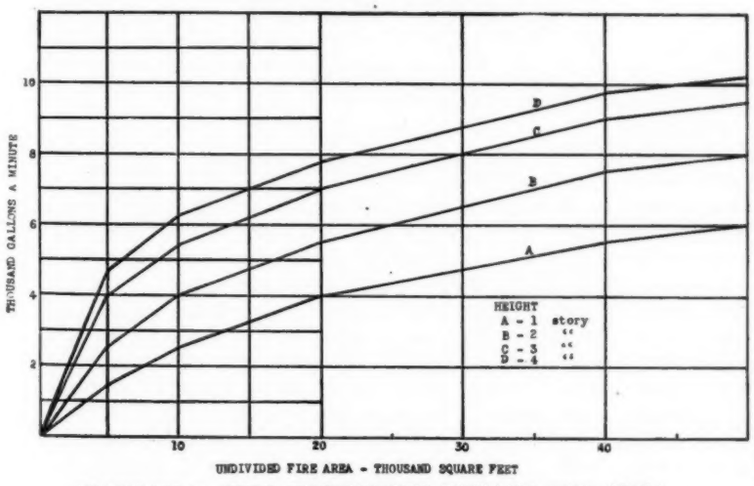


DIAGRAM 2—FIRE PROTECTION DEMAND FOR AREA AND HEIGHT

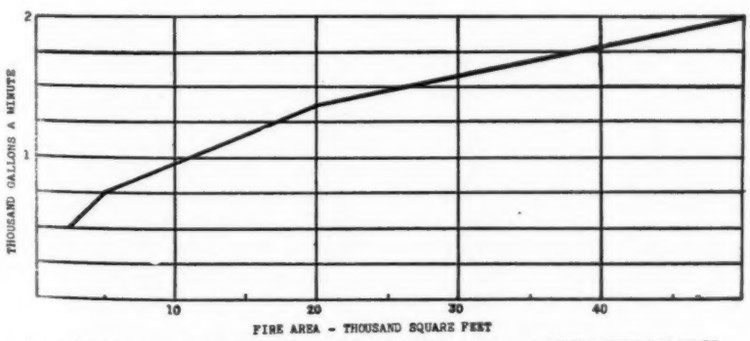


DIAGRAM 3—CORRECTION QUANTITY FOR COMBUSTIBILITY

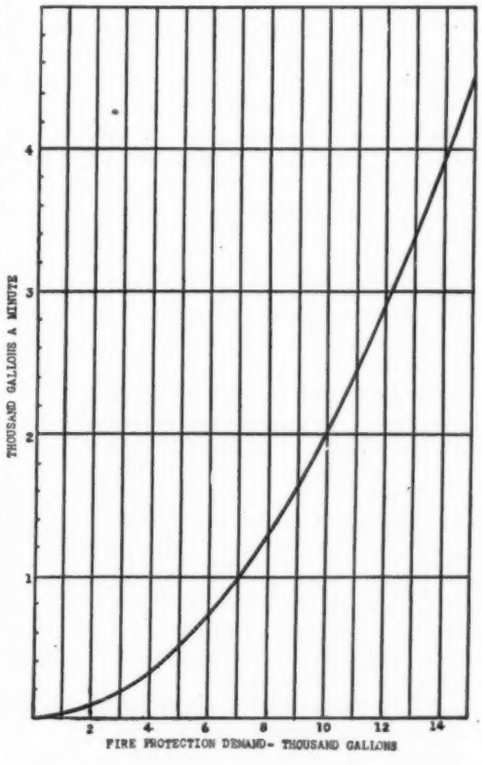


DIAGRAM 5—CORRECTION QUANTITY FOR EXPOSURE

"With regard to the fire hazards implied in the above descriptions of the various zones, that of the industrial zone is about the same as that of the 2nd commercial because of the fact that the exposure factor for industrial areas reduces the quantity of water required for fire protection. Generally speaking, land is not so congested with buildings as in the 2nd commercial zone, but because of the partial insolation of the industrial plants, the necessity of running long lines of hose to reach the seat of the fire, and the fact that the manufacturing processes of many industries and the material handled is highly combustible, the quantity demand for this zone has been made greater than that for the 2nd commercial zone. For the small town, however, it is not recommended to consider demands greater than the 2nd commercial unless actual calculation so indicates.

"Diagrams, 2, 3, 4, and 5 are to be used in calculating the gridiron capacity for which to design in business or mixed areas, where the fire protection water requirement is the fundamental. The formula may be stated by the equation $Q=Q_1$ plus Q_2 plus Q_3 plus Q_4, in which

Q=the fire protection water demand—the basis of design.
Q_1=the quantity required for fire protection based upon the area and height of the probable largest fire area to be involved in a single fire of the greatest fire hazard.
Q_2=a modifying quantity based upon the degree of combustibility of the fire area or contents of structures involved.
Q_3=a surplus quantity based upon the proportion of water wasted in fire fighting.
Q_4=a correction quantity based upon the exposure factor of surrounding areas to the fire area involved—the Baltimore Equation.

"In applying the diagrams for the calculation of the gridiron capacity, proceed as follows:

"By inspection in the field or from study of the local zoning restrictions, determine the probable future maximum fire area and hazard for the district or section of town under consideration and read from Diagram 2 the quantity required for that area and height of structure. The graph for the 4-story height may be taken as the limit; it represents the greatest demand as shown on Diagram 1. Buildings higher than 4 floors are of modern fire proof construction and fires occurring within them can usually be confined to four floors. By the undivided fire area is meant the total area included within walls of definite fire resisting quality carried through the entire structure and ending in a parapet wall well above the roof level; or, it is the total area not separated from adjoining structures by open spaces sufficiently wide to prevent the spread of the fire. It may embrace several buildings or an entire block.

"Having thus obtained Q_1, read from the graph in Diagram 3 the quantity corresponding to the fire area used for Q_1 and if the building or contents is highly combustible this new quantity, Q_2, is added to Q_1; if on the other hand the building or contents is fire resisting, subtract Q_2 from Q_1; and if the combustibility of the building or contents is average Q_2 may be disregarded.

"The purpose of Q_3 is to compensate for the slippage of fire pumps, leakage in hose, and all water discharged from the distribution system during the fire fighting which does not reach the fire or has no part in extinguishing the fire. Q_3 is then an allowance that is proportional to the total capacity of the fire pump apparatus. To obtain this quantity, locate on the graph in Diagram 4, using the values on the perpendicular ordinate, the point equivalent to the total capacity of the average number of fire pumps responding to a fire requiring the quantity of water previously calculated from Diagrams 2 and 3. Then locate a similar point on the graph for the quantity equivalent to the total capacity of all the fire pumps in the town that would be called from their stations for a single maximum fire. Drop perpendicular lines from these two points to the horizontal axis and read the horizontal distance between these perpendiculars in gallons a minute, according to the horizontal scale shown. Add this distance or quantity, Q_3, to the total obtained from the application of Diagrams 2 and 3.

"The total fire protection demand thus far obtained, $Q_1+Q_2+Q_3$, is now referred to Diagram 5 and the corresponding correction quantity read from the graph. If the surrounding and adjacent structures are exposed to fire from two or more sides of the fire area under consideration, the quantity obtained from Diagram 5, Q_4, is added, whereas if there is no exposure to adjacent property Q_4 is subtracted. If exposure is on one side only, provided the length of that side is not greater than one fourth of the perimeter of the fire area, Q_4 is to be disregarded. The result obtained after application of all of the above factors Q_1, Q_2, Q_3, Q_4, is Q, the capacity basis for the design.

"The secondary gridiron may be designed of 10, 12 and 16-inch mains; three 10-inch mains and a 16, then three 10-inch and a 20 or 24-inch primary grid main. Rarely would a secondary system of 8-inch and 12-inch mains be recommended for business developments, except in a small town."

Highway Service Station Signs

The State Board of Health of Delaware and the owners of service stations have combined efforts to safeguard the health of motorists in that state and to afford them sanitary conveniences. Along the roads, signs posting the service stations have been erected indicating that a few hundred feet ahead pure water supplies and sanitary toilets are available. These signs, which were erected by the service stations at an original cost of $6.30 each, are equilateral triangles in shape, 32 inches on each edge, with a green background and white letters and a white border, and bear the blue hen, the insignia of the State of Delaware, at the top, and under it the words "Safe Water and Sanitary Toilets ——— Feet Ahead. Delaware State Board of Health."

Periodic monthly inspection of all signed service stations is made by the State Board of Health, and where sanitary standards demanded by health authorities are not maintained, the signs are taken down. Of these service stations, sixteen are equipped with water under pressure and have flush toilets with connections to septic tanks. The majority provide wash basins, soap and paper towels and cups. Two of the approved stations have shower baths and several provide rest rooms for women.

Recent Legal Decisions

PROOF OF VIOLATION OF GARBAGE DISPOSAL ORDINANCE

The Washington Supreme Court holds, State (City of Auburn) v. Spiller, 262 Pac. 128, that a garbage disposal ordinance, enacted under constitutional and statutory authority, prescribing that the use of the city water by a householder not possessing a garbage can as required by the ordinance should be prima facie proof of violation of the ordinance, is not invalid as unreasonable legislation. The lawmaking body apparently reasoned that the purchaser of water must of necessity be using his premises in such a manner as to accumulate garbage.

CITY NOT LIABLE FOR TRESPASS OF GARBAGE REMOVAL CONTRACTOR

The Mississippi Supreme Court holds, City of Laurel vs. Ingram, 114 So. 881, that where a city employed a city scavenger to remove and dispose of garbage, and fixed his fees and charges, but retained no other control over him, he was an "independent contractor," and the city was not liable for damages for his dumping garbage on an owner's land. Knowledge of the city authorities that the contractor was trespassing would not make it liable; nor would the mayor's act in undertaking to stop the trespass.

RECOVERY FROM CITY ON INVALID PAVING CONTRACT

The North Dakota Supreme Court holds, Stark County v. City of Dickinson, 217 N. W. 525, that where a city, acting in a matter within its corporate powers, undertakes a municipal improvement, such as the grading and paving of streets, and enters into an agreement with another by the terms of which this second party is to advance money to the city for the improvement upon the city's agreement to repay the second party when the improvement is completed and money obtained therefor; and the second party, in reliance upon this promise, in good faith and without intent to evade the law, advances the money by paying a portion of the cost of such improvement, and the improvement is completed and used by the city, and all conditions are fulfilled, recovery may be had of the city, even though the city may have failed to execute a valid contract respecting this improvement by failing to comply with the statutory requirement essential to a valid contract respecting such undertaking.

WHETHER ROAD CONSTRUCTION SEASONAL OR CONTINOUS OCCUPATION

The New York Appellate Division, Hogan vs. Onondaga County, 221 App. Div. 636, 225 N. Y. Supp. 57, holds that whether a highway construction business is continuous or seasonal within the meaning of the state Workmen's Compensation Law, under which the average weekly wages in seasonal employments are computed on the annual earning capacity of the claimant, depends upon the employer's method of doing the business. Ordinarily, in this climate, it is seasonal, since actual road construction is discontinued during the winter months. But if the employer utilizes the winter months in the manufacture of road material and the repair of machinery and equipment, proper elements in the road-building occupation, the occupation is not seasonal, and an injured employee who has only served four days is entitled to compensation based on his average weekly wages on the basis of 300 days to the year for a continuous occupation, instead of 209 days for a seasonal occupation.

REMEDY OF SUBCONTRACTOR'S EMPLOYEE UNDER WORKMEN'S COMPENSATION ACT

The New York Appellate Division, Casey vs. Shane, 221 App. Div. 660, 225 N. Y. Supp. 126, holds that the state Workmen's Compensation Act, Secs. 10, 11 and 56, makes the remedy of an employee of a subcontractor one exclusively under the act, so that the general contractor is immune from liability to such employee in an action at common law for negligence on the theory that the injury was caused by the negligence of a third person.

IRREGULARITIES IN SHOULDER OF PAVED ROAD NOT DEFECTS IN HIGHWAY

The New York Court of Claims holds, Gould vs. State, 130 Misc. 776, 225 N. Y. Supp. 299, that the shoulder of a paved state highway is not constructed to travel on, and irregularities in the shoulder are not defects in the highway, or a menace to the traveling public, in respect of the state's liability for an accident to an automobile crowded off the highway.

STATE HIGHWAY CONTRACT CLAIMS

The New York Court of Claims holds, Hopkins vs. State 131, Misc. 11, 225 N. Y. Supp. 665, that where a road contract provides for top stone to be filled in to the satisfaction of the engineer, it is inadmissible to prove a custom as to quantities in support of a claim that it was more than customary. If the engineer required too much, the contractor had his option to continue or quit, and could not afterwards complain unless he proved that the engineer acted in a capricious, arbitrary, or unnecessary manner.

Extra excavation caused by heavy rains during construction washing the sides of the banks into the road and ditches was held an actual hazard of the contract, for which the state was not liable.

JURISDICTION OF ACTIONS BY MATERIALMEN ON CONTRACTOR'S BOND

The federal district court for Minnesota holds, Kennedy vs. City of White Bear Lake, 22 Fed. (2d.) 862, that a federal court is without jurisdiction, in a suit by the surety on a contractor's bond, to enjoin persons who have furnished labor and materials, and whose unpaid are severally less than $3,000, the limit of federal jurisdiction, although the actions in the aggregate involve more than $3,000, from maintaining actions in the state court, so that controversies may be settled in one action in the federal court. The court said: "While it would be a matter of convenience to the complainants to avoid having to defend a great number of suits in the state court brought by material-men, the decision in one case will settle all the cases."

DEVIATION FROM ROUTE OF COUNTY ROAD VOTED UPON

The Mississippi Supreme Court holds, Board of Suprs. of Lauderdale County vs. Wilson, 114 So. 609, that a board of supervisors could not be enjoined from executing a contract for the construction of a road connecting with a highway of an adjoining county which complied with the dominant purpose of the statute authorizing it, but deviated several miles from the established road specified in the board's resolution and voted upon, where, if the old road were adhered to, it would not connect with the intercounty highway, the route of which had been changed.

RIGHT TO CONSTRUCT TOLL BRIDGE IN CALIFORNIA

The California Supreme Court holds, Newsom vs. Board of Supervisors of Contra Costa County, 261 Pac. 990, that a toll bridge is a part of the public highway. All highways for the use of which the state permits a corporation to take or charge tolls become public highways by force of the right granted, subject to the further right of the licensee to collect tolls for a limited time and at the expiration of said limited period the ways become free public highways. A grant of power to a corporation to engage in the business of constructing private or public buildings, works or improvements does not empower it to exercise the functions of an agent of the government unless the corporation is formed exclusively to perform the particular services described in its charter. In California, a corporation, in order to be entitled to construct and maintain a toll bridge in its own right, must be formed under the statutes enacted for that specific purpose.

FEDERAL GOVERNMENT HELD LIABLE TO TOWN FOR COMPENSATION FOR ROAD TAKEN FOR HOSPITAL

The Circuit Court of Appeals, First Circuit, holds, Town of Bedford vs. United States, 23 Fed. (2d.) 453, that the taking by the United States, by eminent domain, of a public way located in the town for another public purpose, entitles the town to compensation. In this instance, the land taken for a hospital cut out about a half mile of a road, but the severance required new roads to connect the termini. The court distinguished between the relation of the United States to the highway and that of the state; the unlimited power of the latter over property or rights held as a mere agency of the state government resting upon the broad proposition that cities and towns are, for most practical purposes, mere creatures of the state. "But the federal government's power of eminent domain—", the court said, "necessarily implied as an efficient and appropriate means of exercising other powers expressly given—is to be used subject to the broad limitations of the Fifth Amendment. It is a stranger to the town. It can no more take, without compensation, their property rights, than it can those of an individual."

GASOLINE FURNISHED TO SUBCONTRACTORS HELD WITHIN ROAD CONTRACTOR'S BOND

The Oklahoma Supreme Court holds, Eagle Oil Co. v. Altman, 263 Pac. 666, that the Oklahoma statute requiring contractors engaged in making public improvements to execute bond for the protection of persons performing labor or furnishing material in the construction of the public improvement, does not limit labor and material furnished to such as would be lienable under the mechanics' and materialmen's lien statutes. Gasoline furnished to a subcontractor, to be used by him and his subcontractors in performance of a road construction contract, is material furnished in making such public improvement within the statute, for which both principal and surety, under a road contractor's bond given pursuant thereto, are liable.

SWIMMING POOL IN PUBLIC PARK A PUBLIC IMPROVEMENT

The Kansas Supreme Court holds, Smith v. Fuest, 263 Pac. 1069, that the construction of a modern sanitary swimming pool in a public park for swimming and bathing purposes is a "public improvement," and comes within the proper and legitimate uses for which public parks are created.

DISCRETION OF COUNTY COMMISSIONERS—INSPECTION OF ROADS

The Montana Supreme Court holds, Fisher v. Stillwater County, 261 Pac. 607, that, under the general rule that whenever a power is conferred upon the board of county commissioners, but the mode in which the authority is to be exercised is not indicated, the board in its discretion may select any appropriate mode or course of procedure, a commissioner may be appointed orally and by resolution to inspect roads, where the statute authorizing the appointment does not prescribe the mode, and the member so appointed is entitled to the statutory per diem provided by the statute. County commissioners are presumed to do their duty and to exercise fairly their discretion. State v. Wills (Mont.) 261 Pac. 885.

DISCRETION OF CITY OFFICIALS TO DESIGNATE ROUTE OF STATE HIGHWAY THROUGH CITY

Teh Oklahoma Supreme Court holds, Whittington v. Dyer, 265 Pac. 126, that where city officials are authorized to designate the route of a state highway through a city, they are vested with a broad discretion with which courts will not interfere by granting injunctive relief, except in cases of fraud or where there is a manifest or gross injustice which would constitute an abuse of discretion.

CONTRACTOR'S DEFAULT IN ABANDONING WORK MUST BE SHOWN

The Washington Supreme Court holds, City of Seattle v. Sparger, 265 Pac. 173, that the burden is on a city, in an action against its contractor and his bondsman for the contractor's failure to complete a tunnel contracted for, to show the contractor's abandonment of the work. The failure of the city to pay an estimate due for work done, not justified by a previous abandonment of the work by the contractor, would be in itself a breach of the contract justifying the contractor in refusing to proceed with the work.

RIGHT TO TEST VALIDITY OF CONTRACTORS' LICENSE FEE ORDINANCE

The New Jersey Supreme Court holds, Wilson v. Borough of Sea Girt, 139 Atl. 426, that the validity of an ordinance affecting the general public cannot be challenged by certiorari unless the prosecutor shows some injury peculiar to himself; therefore a writ of certiorari for the purpose of testing the validity of a city ordinance requiring a license fee from contractors cannot, it is held, be maintained, in the absence of a showing of a conviction of the prosecutor for a violation of the ordinance.

NEWS OF THE SOCIETIES

Oct. 8-9—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Ninth annual conference at Toronto, Can. Geo. W. Dies, Toronto, Ont., Canada.

Oct. 13-15—CONFERENCE OF STATE SANITARY ENGINEERS. Annual meeting at Chicago, Ill. Hotel Stevens. A. P. Miller, Sec'y, Butler Bldg., Washington, D. C.

Oct. 15-18—SOUTHWEST WATER WORKS ASS'N. Annual convention at Dallas, Texas. L. A. Quigley, Sec'y, Fort Worth, Texas.

Oct. 15-19—AMERICAN PUBLIC HEALTH ASS'N. Annual meeting at Chicago, Ill. Homer N. Calver, 370 Seventh Ave., New York City.

Oct. 16-17—NATIONAL MUNICIPAL LEAGUE. Annual meeting at Cincinnati, O. Russell Forbes, 261 Broadway, New York City.

Oct. 22-26—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention at Detroit, Mich.

Nov. 12-15—ASSOCIATION OF STATE HIGHWAY OFFICIALS. Annual convention at Chicago, Ill. W. C. Markham, Sec'y, National Press Bldg., Washington, D. C.

Dec. 3-7—ASPHALT ASSOCIATION. Seventh annual conference at New Orleans, La. J. E. Pennybacker, Mgr., 441 Lexington Ave., New York City.

Dec. 10-12—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual conference at New York City. Elmer Thompson, Sec'y., 12 E. 53rd St., N. Y.

Dec. 13-14—HIGHWAY RESEARCH BOARD. Annual meeting at Washington, D. C. R. W. Crum, director, Washington, D. C.

Jan. 14-18—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and Road Show at Cleveland. O. C. M. Upham, Washington, D. C.

AMERICAN ROAD BUILDERS' ASSOCIATION AND ROAD SHOW

The 1929 Convention program will consist largely of carefully studied committee reports made by leading officials of states, counties, cities and Latin-American countries. It will again be divided into days devoted to specific types of road work. Manufacturer's Day will be on Saturday, January 12th, preceding the show and convention. The other days are City Official's Day, County Official's Day, Pan-American Day, and Contractor's Day. As the names signify, the program on these various dates will be designed to be of special interest to the particular class of road builders after which they are named.

In addition to reports of the standards committees of the various divisions, the American Road Builders' Association has appointed several special committees to study road problems of general importance. Among these committees is that on Depreciation of Equipment, and a committee on a Study of Lien in Public Construction.

Pan - American Day—Octavio Dubois, President of the Mexican National Highway Commission and President of the Pan-American Division of the American Road Builder's Association, is expected to preside on Pan-American Day. Delegates from all nations on the American continents will be present.

County Highway Division — The nine standards committees of the County Highway Officials Division of the American Road Builders' Association are as follows:

Committeee No. 1—On Surveys and Planning, Stanley Abel, Taft, Calif., chairman. Committee No. 2—On County Highway Construction, Charles E. Grubb, Wilmington, Del., chairman. Committee No. 3—On Rural County Highway Maintenance, F. B. Wilkes, Columbia, Tenn., chairman. Committee No. 4—On Urban County Highway Maintenance, George C. Wright, Delaware, Ohio, chairman. Committee No. 5—On County Highway Legislation, H. B. Keasbey, Salem, N. J., chairman. Committee No. 6—On County Administration, R. B. Preston, Portsmouth, Va., chairman. Committee No. 7—On County Construction and Maintenance Equipment, E. L. Gates, Wheaton, Ill., chairman. Committee No. 8—On County Highway Finance, John J. McHugh, Jersey City, N. J., chairman. Committee No. 9—On Grade Crossings, E. W. James, Washington, chairman.

City Officials' Division—At the meeting of the Executive Committee of the City Officials' Division an outline for committee work for the year was approved. Four major committees have been appointed and have already started a study of the field of city street construction, maintenance and operation.

These committees and sub-committees are as follows:

Committee No. 1—Administration, Organization, Finance, H. C. Whitehurst, chairman. Sub-Committee (1) Organization of Highway Department in cities: (a) Under 100,000 population; from (b) 100,000 to 300,000 population; (c) over 300,000 population. Sub-Committee (2) Methods of Financing for New Pavements. Sub-Committee (3) Contract Procedure. Sub-Committee (4) Selection of Types and Streets to be Paved. Sub-Committee (5) Financing and charges for Openings or Cuts. Sub-Committee (6) Source and Distribution of Funds.

Committee No. 2—Design and Construction, G. B. Sowers, Chairman. Sub-Committee (1) Contracts and Specifications. Sub-Committee (2) Roadway Widths. Sub-Committee (3) Subgrade. Sub-Committee (4) Pavement Bases. Sub-Committee (5) Wearing Surfacing. Sub-Committee (6) Street Railway Tracks and Paving. Sub-Committee (7) Field Engineering and Inspection.

Committee No. 3—Maintenance, C. E. Myers, Chairman. Sub-Committee (1) Pavement Bases. Sub-Committee (2) Concrete Surfaces. Sub-Committee (3) Bituminous Surfaces. Sub-Committee (4) All Types of Block Pavements. Sub-Committee (5) Street Openings or Cuts. Sub-Committee (6) Street Cleaning. Sub-Committee (7) Resurfacing and Salvaging Existing Pavements. Sub-Committee (8) Unpaved Streets.

Committee No. 4—Traffic, M. O. Eldridge, Chairman. Sub-Committee (1) Traffic Lights, Signals and Signs. Sub-Committee (2) Parking Regulations. Sub-Committee (3) Causes of Accidents. Sub-Committee (4) Weights and Loads. Sub-Committee (5) Traffic Zoning and Classifications: One-way Streets, Boulvard Highways, and Truck Routes. Sub-Committee (6) Drivers' Permits. Sub-Committee (7) Traffic Law Enforcements. Sub-Committee (8) Rules of the Road. Sub-Commitee (9) Safety Equipment. Sub-Committee (10 Street Lighting.

Fares and Hotels — Reduced fares have been authorized by the railroads to all persons attending the convention. Certificates will be issued which entitle the delegate to one-half fare on the return journey. Cleveland will be more adequately equipped with hotels for the 1929 session as a result of the construction of new hotels and the enlargement of others.

Reservation blanks for hotel accommodations should be forwarded at once to A. J. Kennedy, vice-chairman of the Hotel Committee, Tower Terminal Building, Cleveland, Ohio. If reservation blanks have not been received they may be obtained by writing Mr. Kennedy.

AMERICAN PUBLIC HEALTH ASSOCIATION

Sewerage systems, sanitation, and water supplies will be major subjects for discussion at the public health engineering sessions of the fifty-seventh annual meeting of the American Public Health Asociation, which will be held October 15-19 at the Hotel Stevens, Chicago.

Five sessions will be given over to public health engineering. The first will consist of symposiums on the milk supply and on sanitation.

The second, third and fourth sessions will be confined to discussions of sewage disposal, sewerage and water systems. A symposium on phenol waste disposal will be held during the second session. The third session will

consist of a symposium on financing water supply and sewerage projects. The fourth session will be held in conjunction with the laboratory section. Reports will be presented on research in sewage and industrial waste disposal.

The fifth session of this group will be given over to such general public health engineering problems as malarial control, carbon monoxide pollution of air, and school room ventilation.

One of the outstanding features of the meeting this year will be the large number of scientific inspection trips to points of interest to public health engineers in Chicago and vicinity. There will be two trips to the north side sewage treatment plant of the Chicago Sanitary District. At the time of the meeting one section of the plant will be in operation and the other two fully completed so that conditions will be most favorable for inspection purposes. Arrangements will be made to visit the west side sewage plant now under construction, which when completed will be the largest Imhoff tank plant in the world.

The newly completed experimental filtration plant now in operation by the city of Chicago will also be visited. A special trip will be arranged for the engineers to see the new city incinerator on Goose Island, which has attracted rather wide professional attention during the last few months. Trips to the new Thomas Jefferson pumping station—Chicago's twelfth—and the Chicago Avenue tunnel still under construction have also been scheduled for engineers.

Following is a partial list of the papers to be presented at these sessions:

Research in Sewage and Industrial Waste Disposal: Can Garbage be Digested with Settling Sludge, Gordon H. Fair, Assistant Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.; Some Biochemical Factors in Sewage Sludge Inoculation, Willem Rudolfs, Chief, Department of Sewage Disposal, Agricultural Experiment Station, New Brunswick, N. J.; Comparison of Stream Flow and Diffused Air Aeration in Purification of Packing House Wastes, Max Levine, Ph.D., Harry H. Jenks and George Nelson, Iowa State College, Ames, Ia.; The Relation of Sulphide Reducing in Sewage, Frank E. Greer, Principal Bacteriologist, Department of Health, Chicago, Ill.; Need for Coordination of Research in Sewage and Industrial Waste Disposal, Clarence N. Baker, Engineer, American Paper and Pulp Association, New York City.

Shellfish Sanitation: The Federal Shellfish Control Program, R. E. Tarbett, Sanitary Engineer, U. S. Public Health Service, Washington, D. C. Discussion: Stephen DeM. Gage, Sanitary Engineer, State Board of Health, Providence, R. I., and Abel Wolman, Chief Engineer, State Board of Health, Baltimore, Md.; Public Health Engineering Standards and Shellfish Sanitation, William F. Wells, Biological Engineer, North Atlantic Oyster Farms, Inc., West Sayville, L. I., N. Y. Discussion: George W. Fuller, Consulting Engineer, Fuller and McClintock, New York, N. Y., and Carl Speer, Jr., Sanitary Engineer, Chicago, Illinois.

Financing Water Supply and Sewerage Projects: Financing Sewerage Improvements. Langdon Pearse, Sanitary Engineer, Chicago Sanitary District, Chicago, Ill. Discussion. Harry F. Ferguson, Chief Engineer, State Department of Health, Springfield, Ill., and J. Ralph Van Duyne, Chief Engineer, Passaic Valley Sewerage Commission, Newark, N. J.; Financing Water Supply Improvements, William H. Duttoe, Chief Engineer, Mahoning Valley Sanitary District, Youngstown, Ohio; Discussion: W. W. Brush, Chief Engineer, Bureau of Water Supply, New York, N. Y. A. K. Warren, Chief Engineer, Sanitation Districts of Los Angeles County, Los Angeles, Calif.; Financing for Water Supply and Sewerage Board, New Orleans, La. Discussion: J. Clark Keith, Chief Engineer, Essex Border Utilities Commission, Windsor, Ont.; Watershed Sanitation. E. Sherman Chase, Metcalf and Eddy, Boston, Mass.

Disposal of Phenol Wastes: Results Obtained in Phenol Waste Disposal under the Ohio River Basin Interstate Stream Conservation Agreement, F. Holman Waring, Chief Engineer, State Department of Health, Columbus, Ohio. Discussion: William L. Stevenson, Chief Engineer, State Department of Health, Harrisburg, Pa. Ellis S. Tisdale, Director, Division of Sanitary Engineering, State Department of Health, Charleston, W. Va., and C. A. Holmquist, Director, Division of Sanitation, State Department of Health, Albany, N. Y.; Industry's Problem in the Disposal of Phenol Wastes, F. F. Marquard, Assistant General Manager, Carnegie Steel Co., Clairton, Pa. S. W. Sperr, Jr., Director of Research, Koppers Company, Mellon Institute, Pittsburgh, Pa., and C. L. Waggoner, Superintendent, Coke Oven Plant, By-Products Coke Corporation, Chicago, Ill.; Biochemical Oxidation of Phenolic Wastes, Floyd W. Mohlman, Ph.D., Chief Chemist, Chicago Sanitary District, Chicago, Ill. Discussion. John F. Skinner, Sanitary Engineer, Department of Public Works, Rochester, N. Y.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS

The 9th conference of this association will be held at the King Edward Hotel, Toronto, Ont., Oct. 8 and 9. The business sessions will begin Monday morning, but there is no set time for the presentation of the papers, except that on Tuesday morning there will be a discussion of the report of the committee to study methods and costs of different garbage disposal systems, the discussion being led by E. C. Goodwin of the New York Department of Street Cleaning. The list of subjects to be discussed is:

Disposal of Garbage by the Fermentation Process, A. Boniface, Village Engineer, Scarsdale, New York; Importance of Street Cleaning—From the Viewpoint of a Physician, Who Is Also a City Official, Dr. M. B. Herlong, City Commissioner, Jacksonville, Florida; The Budget as It Might Be Applied to Street Sanitation Activities, Elmer C. Goodwin, Examining Engineer, Department of Street Cleaning, New York City.

Snow Removal: Three-minute talks by officials from the snow belt; Municipal Parking Grounds as a Means of Helping the Street Cleaning Problem, Robert B. Brooks, Director, Dept. of Streets and Sewers, St. Louis, Missouri; Is It Desirable to Have Street Cleaning Activities Organized as a Bureau or Division of Some Department—If So, Into Which Department Does Such Supervision Naturally Fall? Three-minute talks.

Routine Records of Collection Service, Samuel A. Greeley, Consulting Engineer, Chicago, Illinois; Group Insurance for Municipal Employees, P. J. Hurtgen, Director of Public Works, Kenosha, Wisconsin; Advertising Matter Distributed or Posted on Streets, C. O. Davis, Superintendent of Street Sanitation, Milwaukee, Wisconsin; Handling Complaints, Morris S. Jones, Deputy Commissioner of Public Works, Syracuse, New York.

Vehicle Tax For the Maintenance of Pavements, C. A. Hillegas, Superintendent Dept. of Highways and Sewers, Pittsburgh, Penna.; Duties and Powers that Should Be Delegated to the Street Sanitation Official, Captain Harrington Place, Engineer, Detroit Bureau of Governmental Research, Detroit, Mich.; Maintenance of Sewage Collection Systems, W. K.

Knowlton, Sanitary Engineer, Los Angeles, California; Street Manitenance, R. C. Harris, Commissioner of Works, Toronto, Canada.

Municipal Airports (Motion Pictures Showing Progress During Construction), Edwin A. Miller, Supervisor of Maintenance, Department of Public Works, Rochester, New York; Rules and Regulations Governing the Use and Operation of Airports, Lester W. Herzog, Commissioner of Public Works, Albany, New York.

Alley Cleaning and Requirements of Property Owners in This Respect: Three-minute talks; Public Convenience Stations, Their Construction and Control, W. C. Earle, City Engineer and Superintendent of Streets, Pasadena, California; Benefits to Be Derived From the Use of Mechanical Devices in Street Sanitation Operation: Three-minute talks; Methods Pursued to Prevent Promiscuous Dumping of Rubbish, W. J. Galligan, Assistant Superintendent, Bureau of Streets, Chicago, Illinois; What Is Being Done to Streets on Which Are Located Abandoned Street Car Tracks? L. P. Booz, City Engineer, Perth Amboy, New Jersey.

NEW ENGLAND WATER WORKS ASSOCIATION

From the standpoint of attendance and general interest, the New England Water Works Association meeting held in Montreal, September 18-21, inclusive, was notable. This meeting was the 47th Annual Convention of the New England Water Works Association, with which was affiliated four of the local sections of the American Water Works Association, namely, the New York, Central States, Four State, and Canadian. The total registration was slightly in excess of 600, made up of some 160 active members of the New England, some 80 members of the American Water Works Association, some 130 associates of both associations, while the balance were guests.

The water works people were welcomed to the city in a brief but cordial address by the pro-Mayor, Mr. Matthewson. The opening sessions presided over by Acting President Arthur D. Weston, were taken up chiefly with report of officers and standing committees. The annual award of the Dexter Brackett Memorial Medal for the best paper during the preceding year was awarded to H. W. Clark of Boston for his paper on "The Effect of Pipes of Different Metals Upon the Quality of Water Supplies."

The papers given during the meetings which dealt with a somewhat wider range of subjects than is ordinarily covered by the New England meetings, were well received and evoked considerable discussion. The round table discussions of the superintendents' conferences, as usual were very well attended and brought much discussion particularly the Wednesday discussion on electrolysis.

The entertainment provided in connection with the Convention added much to the enjoyment of the members and guests. For the men these included an inspection and luncheon at the plant of the Consolidated Pipe Co., Ltd., on Tuesday, an inspection and luncheon at the Montreal Filtration Plant on Thursday, and a boat trip through the Lachine Rapids on Friday. For the ladies there was a special trip to Mount Royal, a theatre party, shopping tours, and reception and bridge at the Windsor Hotel. The Tuesday night informal reception and dance and the Thursday night dinner dance and entertainment, furnished by courtesy of the Manufacturers Association, added greatly to the enjoyment of the week.

The officers of the New England Water Works Association elected for the coming year are: Arthur D. Weston, President; Robert Spurr Weston, First Vice-President; George H. Finneran, Second Vice-President; and Albert L. Sawyer, Treasurer. The The new directors elected are Karl R. Kennison and Richard H. Ellis.

ASPHALT PAVING CONFERENCE

Conflicting meetings have made it necessary to move forward the date for the Seventh Annual Asphalt Paving Conference to be held this year in New Orleans and, accordingly, the meeting will be held during the week of December 3rd, instead of that of December 10th, as previously announced. The technical sessions will continue for three days, beginning on Tuesday, December 4, and continuing until Friday, December 7.

Asphalt paving at airports will come in for thorough discussion. Among those who are expected to participate in the discussion are William P. MacCracken, assistant secretary of commerce in charge of aeronautics; Col. H. H. Blee, engineer for the Aeronautical Division, Department of Commerce, and several consulting or construction engineers prominent in the work of designing and building commercial and municipal airports.

The program will also consider economic and technical questions of importance to the good roads movement. The possibilities in the surface treatment of the many hundred thousand miles of roads that constitute the secondary highways of the country will be covered by a group of authorities, headed by E. W. James, chief of the Division of Design, U. S. Bureau of Public Roads.

Radical strides in development have been made recently in the mechanical equipment and operations involved in the construction of asphalt pavements and in the technique of asphalt construction, and these developments will be presented by T. Warren Allen, chief of the Division of Control, U. S. Bureau of Public Roads; M. H. Ulman, of the Pennsylvania State Highway Department; Prevost Hubbard, chemical engineer of the Asphalt Association, and others.

Service results in the use of asphaltic concrete (black base) in California have induced the attendance of engineers from that state to present the results of their experience to the conference. Chris P. Jensen, county engineer of Fresno County, Cal., will present his experience with this type of paving.

Another feature of importance from the standpoint of practical first-hand information will be a series of papers by the heads of various state highway departments telling what results they have obtained with all forms of asphaltic construction and surface treatment. States which have had experience along these lines include Massachusetts, Michigan, Louisiana, Tennessee, North Carolina, Georgia and California, and also the Province of Ontario.

The first day, Monday, will be devoted to registration and committee meetings. Tuesday will be devoted to the opening morning session, followed in the afternoon by a boat ride and inspection trip on the Mississippi River and Lake Pontchartrain, with the New Orleans Refining Company as host. The asphalt technologists will meet in the evening. On Wednesday there will be morning and evening technical sessions and the afternoon will be devoted to a specially conducted trip to the racetrack, where the Standard Oil Company of Louisiana will be host to those attending the convention. On Thursday there will be morning and afternoon technical sessions. During the day a special social function is arranged for ladies, consisting of a luncheon with a talk by Dorothy Dix and a trip through the French quarter of New Orleans. Thursday evening there will be a carnival ball, with the Mexican Petroleum Corporation as host. This ball will be a replica of one of the famous Mardi Gras balls and will be held at the Athenaeum.

A national engineering committee is being constituted under the chairmanship of Maj. J. M. Fourmy, state highway engineer of Louisiana. A research committee is also being formed with W. J. Emmons, associate professor of civil engineering of the University of Michigan as chairman. The personnel of this committee will be selected by the Association of Asphalt Paving Technologists of the United States and Canada, of which Mr. Emmons is first vice-president.

Presiding officers at the various sessions will include: Chairman, State Highway Commission of Louisiana; J. N. Holder, chairman, State Highway Board of Georgia; Capt. H. C. Whitehurst, assistant engineer commissioner of the District of Columbia; John M. Mackall, chairman of the Maryland State Road Commission, and others.

MISSOURI CONFERENCE ON WATER PURIFICATION

The fourth annual meeting of the Missouri Conference on Water Purification will be held at Hannibal, Mo., November 15, 16, 17, 1928. The program to be rendered at this meeting will include the following subjects: Water Purification, Deep and Shallow Well Supplies, and Sewage Treatment. H. D. Peters, State Board of Health, Jefferson, Mo., is secretary.

PERSONALS

H. O. Tatum has been appointed city manager of Eastland, Texas.

John F. Donovan, for eight years division engineer of District No. 1, Colorado Highway Department, has been appointed assistant superintendent of maintenance.

Chas. H. Whitmore has been appointed District Engineer of District I, California Division of Highways with headquarters at Eureka. Mr. Whitmore was formerly Assistant District Engineer of District IV, with headquarters at San Francisco, and was also Assistant Construction Engineer with headquarters at Sacramento. Mr. Whitmore succeeds T. A. Bedford, who resigned to accept a position in Cuba.

R. E. Pierce and E. E. Wallace have been appointed District Engineers California Division of Highways for District X, headquarters, Sacramento, and District VI, headquarters, Fresno, respectively. Both have been serving in an acting capacity.

T. H. Dennis, who has been serving as Acting Maintenance Engineer, of the California Division of Highways, has been appointed Maintenance Engineer.

John Foushee, who has been acting city engineer for the past year, has been appointed city manager of Chapel Hill, N. C. Mr. Foushee is a graduate of the school of engineering of the University of North Carolina, and at the present time is an instructor in the engineering school.

CIVIL SERVICE

Associate Land-Clearing Specialist.—Applications for associate land-clearing specialist must be on file with the Civil Service Commission at Washington, D. C., not later than October 24. The examination is to fill vacancies in the Field Service of the Bureau of Public Roads, Department of Agriculture. The entrance salaries range from $3,200 to $3,700 a year. Higher-salaried positions are filled through promotion. The duties are in connection with original research and investigation relating to the clearing of agricultural land.

Applicants must have a degree of engineering, agriculture, or forestry, or closely allied branch. In addition, applicants must have had at least three years of progressive professional experience in engineering, agriculture, or forestry; provided that one year of postgraduate study, majoring in one of these subjects, may be substituted for one year of this experience. The whole must have included at least two years of responsible experience in large-scale land-clearing operations, in demonstrating land-clearing methods, or in otherwise acquiring the special ability and qualifications required for conducting research in land clearing. Competitors will not be required to report for examination at any place, but will be rated on their education, training, and experience.

Junior Cartographic Engineer.—Applications for junior cartographic engineer must be on file with the Civil Service Commission at Washington, D. C., not later than October 24. The examination is to fill vacancies in the Coast and Geodetic Survey, Department of Commerce, for duty in Washington, D. C., or in the field. The entrance salary is $2,000 a year. Higher-salaried positions are filled through promotion.

The duties are technical in character, and consist in the utilization of the data resulting from the field survey of the Bureau, or other sources, in the compilation and correction of nautical charts which guide all vessels traversing the navigable tidal waters of the United States and its possessions, and of other professional work in related physiographic problems. Competitors will not be required to report for examination at any place, but will be rated on their education, experience, and fitness, and topographic drawing and lettering.

Principal Architectural and Structural Steel Draftsman.—Applications must be filed with the Civil Service Commission at Washington, D. C., not later than October 24. The examination is to fill vacancies in the Lighthouse Service, Department of Commerce, throughout the United States. The entrance salary is $2,300 a year. Higher-salaried positions are filled through promotion. The duties, under general supervision, are to perform difficult free-hand or architecural and structural steel drafting, requiring judgment, skill, and a thorough knowledge of the customs and practices of the drafting occupations in expressing ideas, plans, and data in drawings; or to supervise the work of a group of draftsmen of lower grades. Competitors will not be required to report for examination at any place, but will be rated on their education, experience, and fitness, and specimens of drawing and lettering to be filed with the application.

Information.—Full information regarding the above examinations may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of the United States Civil Service Board of Examiners at the post office or customhouse in any city.

PUBLIC REPORTS

Absorption of Sound by Materials. By Floyd R. Watson. Bulletin 172 of the Engineer Experiment Station of the University of Illinois.

The object of the investigation was to determine experimentally the absorption coefficients for a number of materials for the information of architects and others interested. The theory and method of measurement are described at some length in the bulletin. Tables giving coefficients for the materials usually found in auditoriums are also included. From the results obtained it has been found that absorption of sound by materials is due to the porosity, compressibility, and elasticity; that materials that are finished in the factory are more likely to have laboratory coefficients than materials that are installed on the job, where the skill of the workman determines the efficiency; that the painting or decoration of materials is a very important consideration, that is, if such painting closes the pores of the material, or if painting a membrane stiffens it, the absorbing efficiency is reduced; and that porous membranes over materials do not have a marked effect, because sound passes through the open work in the mesh. Copies of Bulletin No. 172 may be obtained without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

Water Resources of Hawaii. Water Supply Paper 575, U. S. Geological Survey, Washington, D. C. 175 pp. 25 cents. (From Superintendent of Documents, Washington, D. C.)

The Hawaiian Islands can boast of having one of the greatest rainfall centers in the world. They also have areas where the rainfall is light, with almost semidesert conditions. The annual rainfall in different localities ranges from over 600 inches down to less than 15 inches and this causes a correspondingly wide range in the water supplies of different parts of the islands.

Owing to the tremendous variation in the rainfall and the wide range in the flow of the Hawaiian streams it is impracticable to make even approximate estimates of the flow of one stream from records collected on another, as is done more or less successfully in parts of the world where the rainfall is more nearly uniform. It will therefore be necessary to conduct measurements of all the streams in the islands if the most intelligent use is to be made of the water. Up to the present time the investigations of the surface waters of Hawaii have, on account of the meager funds available for such work, been confined to the streams and ditches on the larger islands which are either being utilized already or on which development is contemplated.

This report is for the year ending June 30, 1923.

New Appliances

Describing New Machinery, Apparatus, Materialsand Methods and Recent Interesting Installations

Greiman Trencher

The Greiman Ditcher Co., Garner, Ia., manufactures a line of three standard trenchers, all of which are of the same design. The model 12-40 special, which is suitable to a wide range of work, will

GREIMAN DITCHER

cut a trench from 22 to 40 inches wide, to 15 feet deep. The smaller model, the 8-24, cuts 20 to 28 inches wide and to a depth of 10 feet; the 15-48 cuts to a depth of 20 feet, and any width from 22 to 48 inches.

The boom of Greiman trenchers is of the box type, constructed from two 8-inch channels, top and bottom, with riveted side plates. A power shift conveyor delivers material to either side of the trench, changes being made readily by shifting a lever. The conveyor can be folded quickly when it is desired to move the ditcher.

The weight of the 12-40 special is about 28,000 pounds; the wheel base is 15 feet 10 inches; the overall width of the machine 8 feet 8 inches; the shipping height 9 feet 10 inches and the operating height 11 feet. A 4-cylinder heavy duty motor is used. The road speed on high gear is 2 miles per hour; on low gear 1¼ miles. The digging traction speed is through selective sliding gears, giving a range of speed from 6 inches to 8 feet per minute.

Stolle Stone and Gravel Spreader

The Stolle Spreader Sales Co., St. Louis, Mo., have brought out the Stolle Spreader, which is designed to spread evenly any aggregate from sand to 3-inch stone. No part of the spreader touches the roadway.

STOLLE SPREADER

The Stolle spreader can be attached to any hoist dump truck, by fastening two hooks, one midway on each side of body of truck, placing two hooks on the rear end of truck body and connecting the chain driving device. The spreader has folding legs which will support it at the proper height when changing the spreader from one truck to another. The legs are detachable, so that it is not necessary to carry them on the spreader unless it is intended to change the spreader frequently.

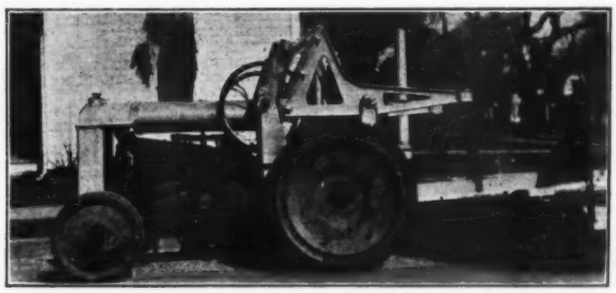
When ready to spread aggregate, the body of truck is raised and the tail gate released. This permits the material to flow into the hopper of the spreader, which contains agitators which revolve, keeping the material thoroughly churned to assure an even flow through the adjustable shutters which can be regulated to spread the required amount. Material, after leaving the hopper, drops upon the corrugated roller which revolves rapidly, causing an even, uniform spreading of fine aggregate. When spreading a heavy course, or coarse aggregate, the roller can be removed by taking out eight stud bolts in roller brackets, and equally good results obtained without the use of the roller.

The hopper has shutters to control the depth and width of deposit, the depth ranging from 3 pounds of dry sand to 200 pounds of coarse aggregate, to the square yard; and the width, from eight inches to eight feet. One or more shutters can be closed, permitting the filling of ruts in the road, if desired. Spreading is equally efficient whether the truck is driven forward or backward. The flow of aggregate will not be stopped or retarded on account of an occasional excessively large stone being contained in the load, as the agitators will keep such large pieces moving away from the opening, thus permitting a steady flow of material continuously until the load is spread, when the large pieces remaining in the hopper can be removed.

"Caterpillar" Ten Tractor

The Caterpillar Tractor Co. announces the "Caterpillar" Ten Tractor, for production and sale about the first of 1929. Prices and detailed specifications of the Ten will be announced later to dealers and to the public. It is known at this time, however, that the new model offers ten horsepower at the drawbar and fourteen horsepower on the belt. The engine bore and stroke are 3⅜ and 4 inches respectively—engine speed 1500 revolutions per minute.

"Caterpillar" Ten weighs approximately 4,000 pounds. From the tip of the starting crank in front to the rearmost point of the drawbar, it measures a fraction less than 100 inches in length. Measuring from the outer edges of the tracks, its width is less than four feet. The radiator cap, the high point of the tractor, is approximately 51 inches above the ground.



K. M. GRADER PATROL

The Ten follows in general details the proven principles of "Caterpillar" design. It is steered by engine power through individual steering clutches and individual brakes, permitting quick, short turns and full power on the turns. It has the highly developed features of protection against dust and dirt, air cleaner, oil seals, a carefully worked out and thorough lubrication system, and extensive use of heat-treated, wear-resistant steels.

K-M Grader Patrol

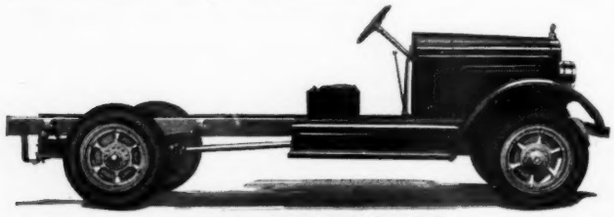
The Landreth Machinery Company of Joplin, Missouri has perfected a new pull-type road grader which may be attached in a few minutes' time to any standard tractor and is operated by a simple device under direct control of the driver.

Two wheels on either side of the tractor driver to control the vertical adjustment of the blade are the only controls necessary. The grader is manually operable both laterally and longitiudinally without a fixed center point. A spring and hinge device gives the blade the predetermined pressure and keep the blade in constant contact with the ground while passing over uneven surfaces. There are no additional wheels or tracks and the grader does not alter the tractor in any way.

Lakewood Water Regulator

The Lakewood Engineering Co., Cleveland, O., has developed a water regulator to control the water-cement ratio. The Lakewood Water Regulator is a tank which, it is claimed, will give absolute accuracy of discharge, batch after batch, for any given setting. The upper part of the measuring dial scale is marked in gallons to conform to the water cement ratio while the lower scale is in pounds. A double pointer is provided on the lever so that a given setting of the tank can be read simultaneously in gallons and pounds. For example, assume a mix requiring 48 gallons of water and with that mix a compensation for 40 pounds of moisture in the sand. The lever would be set at 48 on the upper scale and then moved back 40 pounds on the lower scale to 360 pounds.

This device can be attached to any make of mixer in the field, and is stated to give an accurate and easily controlled method for maintaining the proper water cement ratio.



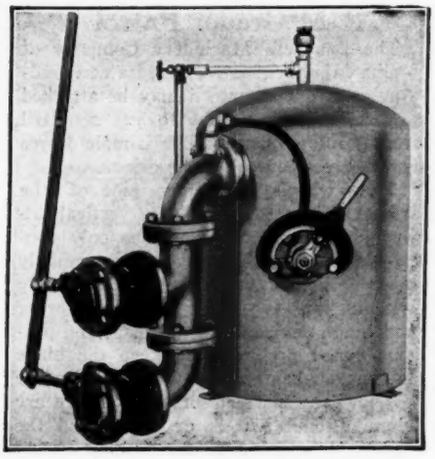
WILLYS-KNIGHT TRUCK

Willys-Knight Trucks

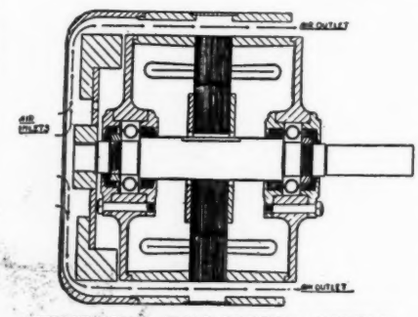
Willys-Overland, Inc., Toledo, O., has brought out a line of Knight-motored six-cylinder trucks ranging in size from 1 to 2½ tons. Among the features of these trucks are: extra deep, low-hung frame; metal spoke wheels; pneumatic cord tires on all models; dual rears on the 2½-ton model; bevel-drive rear axle in the 1, 1½ and 2-ton and double reduction drive rear axle in the 2½-ton; Hotchkiss drive; smooth, sure-acting clutch; and chrome vanadium steel springs. The rear springs of the 1½, 2 and 2½-ton trucks are of the two-stage or progressive type. A main spring is provided, designed to carry a light load. A helper spring mounted underneath but integrally assembled, comes into use for maximum rated loads. Thus light loads are not tossed about.

Electric equipment includes generator, electric starter, electric head and tail lamps, heavy-type battery and electric horn. Four-wheel brakes are standard.

The 1-ton has a wheelbase of 130 inches, and the chassis weight is 2,775 pounds. The capacity is 2000 pounds, with an allowance of 750 pounds for body weight. The 1½-ton is made in 2 models, the wheelbases being 136 and 151 inches and the weight 3300 and 3400 pounds. Models 20 and 21 are of 2-ton capacity, with 150 and 164-inch wheelbase, and a chassis weight of 3800 and 3900 pounds. Models 25 and 26, 2½-ton capacity, have the same wheelbase lengths, but weigh about 5000 pounds, exclusive of the body. The engines of the two smaller trucks develop 48 horse power at 2600 r. p. m.; those of the larger trucks develop 68 horse power.



LAKEWOOD WATER REGULATOR



ENCLOSED FAN-COOLED MOTOR

Fan-Cooled Totally Enclosed Motor

The Cleveland Electric Motor Co., Cleveland, O., has placed on the market a new type totally-enclosed fan-cooled electric motor, which is designed to meet exceptionally severe operating conditions.

The new Cleveland "Security" ball-bearing type totally-enclosed motor eliminates the possibility of even the smallest dust-leakage along the shaft into the windings. The motor is built with a double shell. The inner shell, which contains the entire motor, is completely enclosed and entirely dust-proof. This inner shell is mounted in the outer shell so as to allow a free air-space between them—the shaft passing through both. One end-cover of the outer shell is provided with holes for admitting air.

At the end away from the motor pulley, a fan is mounted in the space between the inner and outer end-covers. This draws in a steady current of air through the holes already mentioned and blows it over the outer surface of the inner shell.

Thus although dust is permanently excluded from the working parts, ample cooling effect is obtained—in fact, the makers state that this type of motor permits practically the same rating for a given frame size as an open type motor.

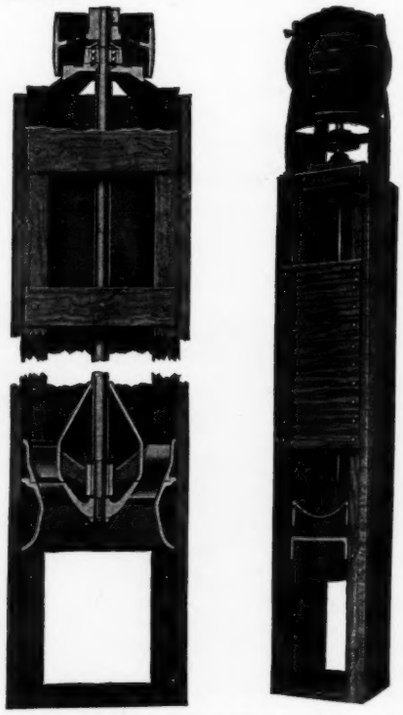
"Everglades" Screw Pump

Fairbanks, Morse & Co., Chicago, Ill., have recently developed the Everglades screw pump. This pump obtained its name "Everglades" in view of the fact that it was developed particularly for drainage work such as is encountered in the Everglades of Florida. The pump is a vertical machine consisting of cast iron spiders, carrying a Wood screw type impeller and diffuser, and constructed in such a manner, that four wooden corner posts are fastened to the spider and the structure boarded up so that it may be placed vertically in a ditch or stream and arranged to discharge over the top of a levee, or embankment.

The pump was developed primarily with the idea of providing a low priced and efficient unit for moving large volumes of water against a low head. It is anticipated that there will be a field of use for the Everglades screw pump wherever low head, drainage or irrigation work is encountered. This pump may be used in the rice fields and in those districts where it is necessary to flood cranberry bogs.

The pump is well adapted for direct connection to vertical motors, for belt drive from motors or internal combustion engines, using ¼ twist belt, or by means of a gear box, which may be provided at the top of the pump. It may be direct connected to internal combustion engines or may be belted through the gear box, thus eliminating the quarter twist in the belt.

Bulletin No. 5315, which will soon be ready for distribution, will give a full description of this new Everglades pump.

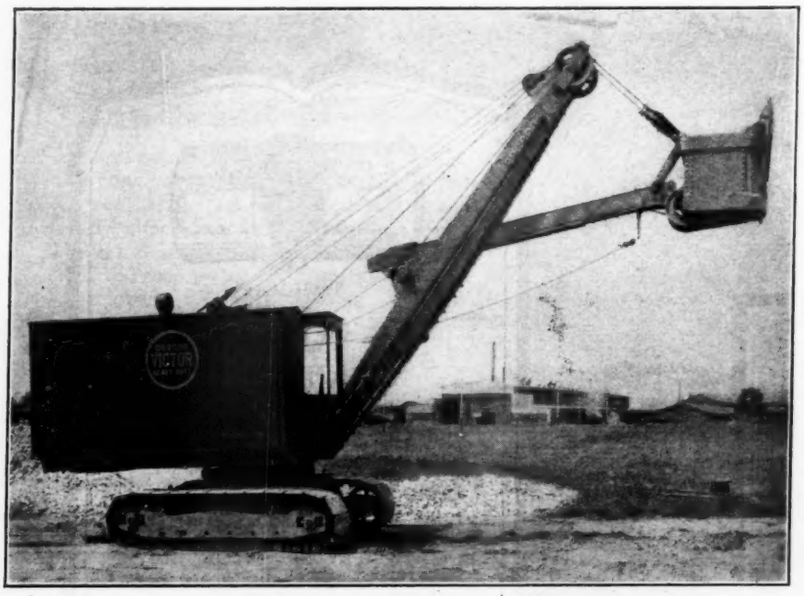


"EVERGLADES" SCREW PUMP

New Ingersoll-Rand Portable Air Compressor

Ingersoll-Rand Company, New York, has added a seventh size to its line of portable air compressors. This new size (4¾-inch bore by 4-inch stroke) has a piston displacement of 82 cubic feet per minute. It is intended primarily for use by contractors, public utilities, cities, towns, etc., requiring a unit of slightly larger capacity than the 4¼-inch by 4-inch 66 cubic feet machine.

The new compressor, like the other 1-R portables, is equipped with a four-cylinder, tractor-type Waukesha motor. It is available on broad-faced steel wheels, on steel wheels with rubber tires, on I-R trailer mounting, on Ford or Chevrolet truck, or without running gear for mounting on skids, railway car, etc. The 4¾-inch by 4-inch unit embodies all the Ingersoll-Rand features which are found on the other six sizes.



OSGOOD VICTOR HEAVY DUTY SHOVEL

Osgood Victor Gasoline Shovel

The Osgood Co., Marion, O., has just brought out the Victor, a new gasoline shovel. This incorporates many of the features of the Conqueror shovel (described in PUBLIC WORKS, May, 1928, p. 44) but is a larger machine and designed for greater capacity and heavier work than the Conqueror. The Victor for shovel service will carry a 22 or 24-ft. boom, a 15 or 16-ft. handle and a 1½-yard or 1¼-yard dipper, depending upon the characteristics of the material to be excavated and the nature of the job to be done. For crane or dragline service a structural lattice bow type boom with built-in tagline and with a fairlead for dragline service that is self-adjusting to any angle of the boom is furnished. A 45-ft. boom with 1¼-yard bucket, or a 50-ft. boom with 1-yard bucket, may be used.

In changing the Victor from one class of service to another such as shovel to clamshell, back hoe or dragline, no additions or changes are necessary in the operating machinery. The attaching and reeving up of the proper boom assemblies and buckets are the only changes necessary. This work may be done in the field in a very short space of time.

The well-known Osgood constructional features have been retained in the Victor, such as combination cast iron gasoline tank and counterweight which is mounted on the deck level, large sized motor equipped with storage battery, electric starter, voltage regulator, gasoline filter, muffler and air cleaner.

The hoisting and crowding motions are timed and co-ordinated, making it easy to cut to any grade desired. The use of two drums make it unnecessary to add to the machinery when shovel is converted to clamshell or dragline.

The Victor, is mounted upon a truck of new and improved design that is the result of years of experience in the designing of truck frames. It is very heavy and rugged, exceedingly simple in construction, easy to control and maintain in operation. It has a travel speed of approximtaely seven-tenths miles per hour and will negotiate grades up to thirty per cent.

The Victor, is claimed to be an economical machine to use in any type of service, with its various attachments, from the lightest to the heaviest kind of work. It may be had as shovel, dragline, back-hoe, crane or clamshell and in any or all combinations.

Heil Hand Hoist

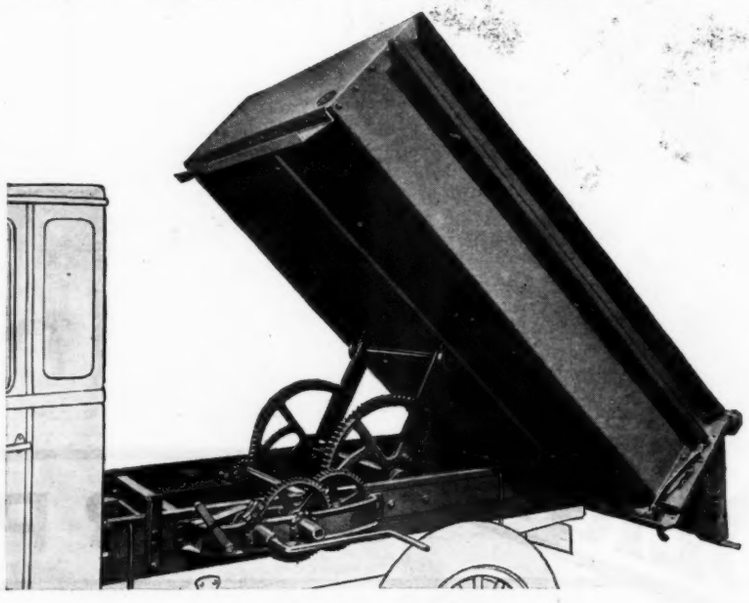
The Heil Co., Milwaukee, Wis., manufactures an improved hand hoist for dump trucks. This hoist is designed to assure positive action with the least operating effort. A set of driving gears, cut on a Fellows Shaper, accurately mesh with a minimum amount of friction. Two gear segments, to which are bolted the lifting arms, are operated by the driving gears.

An ingenious combination of roller and angle track grip, on the ends of the lifting arms, allows free travel along a steel track, riveted to the longitudinal body members, and eliminates "body jumping" while riding light or the possibility of "back tipping" when body is in dumping position.

The body may be held at any desired angle by the two-way hoist lock provided.

A double crank socket arrangement makes it possible to dump a light load unusually fast by inserting the crank in the direct gear socket. With 48 turns of the handle in the low gear socket, the body can be raised to full 45 degrees dumping angle. Ten turns of the crank handle in the direct gear socket accomplishes the same result. A friction brake controls the return of body to loading position.

The entire hoist mechanism is permanently mounted on a channel iron frame which is easily attached to the truck chassis frame with U-bolts.



HEIL HAND HOIST

Prest-O-Lite Flood Light Attachment

The Prest-O-Lite Co., Inc., New York City, announces a flood light attachment of new design for use with their small tanks of dissolved acetylene, the same as are used for truck and tractor lighting. Prest-O-Lite gas tanks are available from service stations throughout the country. By the connection of the attachment a convenient, portable, powerful flood lighting unit is obtained which can be used for illumination in dark places and for facilitating night work of all kinds.

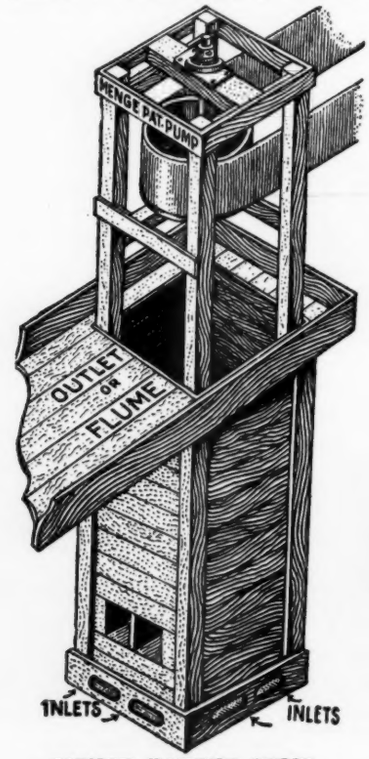
The improved attachment is of simple, strong, rigid and compact construction. Universal adjustment is obtained with only one swing joint, thus minimizing the possibility of leakage. Because of the substantial construction of the new part and because of its position near the center line of the tank, the attachment itself can be used as a handle in carrying the entire unit.

The reflector, which is 10 inches in diameter can be taken off by removing a single knurled nut. A new type of burner is used which, it is claimed, will not "carbon up." This burner is placed at a fixed focal point and requires no adjustment.

Menge Patent Pumps

The Menge Pump and Machinery Co., Ltd., New Orleans, La., manufactures a rotary pump which is claimed to be especially valuable in drainage or irrigation work because it is very simple, low in first cost and exceedingly economical. It handles large volumes under low heads at very low cost.

The water entering below and above the impeller gives it a hydraulically balanced runner. Owing to the large openings or water passages, there is less friction and thereby the efficiency is increased. The pump box proper takes the place of the intake and discharge pipe. It therefore eliminates the expense of intake and discharge piping, elbows and priming device.



MENGE PATENT PUMP

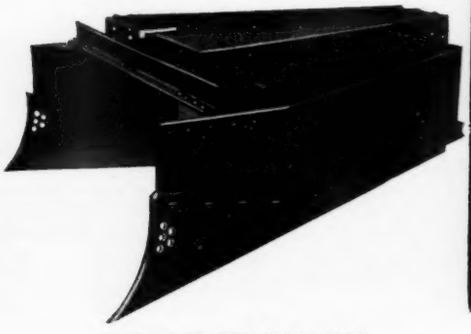
PREST-O-LITE FLOOD LIGHT ATTACHMENT

Drive is by means of a pulley mounted at the top of the pump, the power being transmitted through a perpendicular shaft suspended from a steel-lined ball-bearing.

Atlas Chemical Weed Killers

The Chipman Chemical Engineering Co., Inc., Bound Brook, N. J., manufacturers of two kinds of weed killers. Atlas "A" is an arsenical product; Atlas Non-Poisonous Weed Killer is a patented compound, one application of which, properly diluted with water, will kill all plant life, both tops and roots. It is claimed to be absolutely harmless to animal and bird life, is odorless and colorless and will not stain stone, cement, wood or clothing.

Atlas "A" is especially recommended for use in and around industrial plants to lessen fire hazards due to weeds and grass, and on railroad rights-of-way. Atlas non-poisonous weed killer is suited to use on driveways, roads, tennis courts and paths, and along fence lines.



GARST PLOW SCRAPER

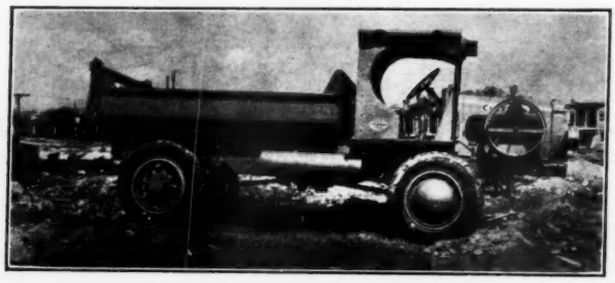
Garst Power Plow Scraper

The Garst Manufacturing Co., Chicago, Ill., manufactures the Garst power plow scraper, which is essentially a right and left hand plow, joined at the rear, and having a vertically adjusted cover plate which stops all over-digging and can be adjusted to increase or decrease the normal capacity. The plowshare front ends are removable so that different shapes can be used in different soils. Teeth are seldom necessary as the construction is such that the scraper naturally digs in. It is made in sizes from 1-3 to 6 yards.

This scraper is claimed to offer a most economical method of excavating for a large majority of the sand and gravel plants. The maximum efficient operating distance will vary, but in most cases it will be four hundred feet or more for the larger type power scrapers and three hundred feet for the smaller power scrapers. The amount of gravel that can be delivered by a given sized scraper depends, of course, on the distance it travels, the speed of the inhaul, and the return trip. The most efficiency is obtained by using a hoist which gives a return speed which is three times the speed of the inhaul. This requires the use of a special scraper hoist. Special blocks are needed due to the unusual strain and wear given in power scraper operations. It is stated that a one-yard power scraper operating on a three hundred foot span will deliver approximately twenty-five yards of material per hour; a two-yard scraper, using this span, fifty yards per hour;

GARST SCRAPER AT WORK

or a one-yard scraper working on a maximum radius of 150 feet would produce fifty cubic yards per hour. This production can be obtained by a force of one or two men. The economy of a power scraper results not only from the small amount of man power required to operate, but also from the



COLEMAN FOUR-WHEEL DRIVE TRUCK

fact that the weight of the material moved in each load weighs about twice the weight of the scraper. This is a relation that, it is claimed, cannot be equalled by any other method of excavating.

Coleman 4-Wheel Drive Motor Trucks

Coleman Motor Corporations, Littleton, Colo., and Washington, D. C., manufacture 4-wheel drive motor trucks in 2, 3 and 5-ton sizes. These trucks possess many features in addition to the 4-wheel drive, including easy steering, eight forward and two reverse speeds, road speed up to 30 miles per hour, 4-wheel brakes, and 6-cylinder Buda motors. Other standard equipment includes Fuller transmission, Ross steering gear, Spicer joints and shafts, and Wisconsin axles. Parts are readily interchangeable. Weight is evenly distributed, so that both axles share evenly when the truck is fully loaded.

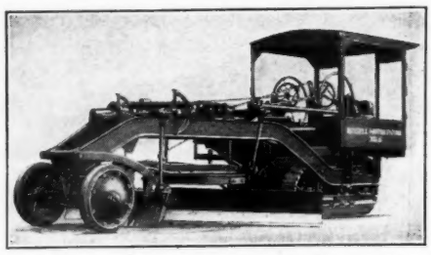
The C-25, equipped with a 51 h.p. Buda motor, has a gear ratio varying from 7.25:1 to 139.2:1. The speed is 30 miles per hour. Wheelbase is 109 inches; weight, with cab, 5,360 pounds; body allowance, 1,000 pounds; pay load, 2 tons.

The D-40 has a 60 h.p. Buda motor, a speed ratio varying from 8.33:1 to 159.2 :1, and a speed of 30 miles per hour. Wheelbase is 130 inches; weight, with cab, 8,100 pounds; body allowance, 1,500 pounds; pay load, 3 tons. The truck is especially suited to road maintenance and high speed snow removal work.

The X-100, 5-ton truck, is specially fitted for heavy work under most severe conditions. The Buda motor develops 78 h.p.; the weight is 9,240 pounds, without body; with a 2,000-pound body, the pay load is 5 tons.

New Russell Motor Patrol No. 6

The Russell Grader Mfg. Co., Minneapolis, Minn., has announced a new motor patrol called the Russell Motor Patrol No. 6. It is built expressly for the "Caterpillar" 20 Tractor; being very sturdily constructed, it will withstand the strain caused by the increased power of the "Caterpillar" 20 Tractor. The circle on the Motor Patrol No. 6 is reinforced with an extra angle iron, and provided with a clamp consisting of a screw clamp contact to the circle. There is a plate on the end of the screw which prevents the circle from becoming defaced. The blade side shift is a rack and pinion type operated by a worm and gear. The worm and gear are enclosed in a metal housing. The blade lift is worm and gear type. The worm and gear are machined cut, enclosed in dust proof cases. The gear is of the ring type and may be shifted to five different position for wear. Ball and socket connections are used in



RUSSELL MOTOR PATROL

the lifting links. The ball is 2½ inches in diameter. The sockets are split and steel shimmed to allow for take-up. The compensating spring blade lift consists of a tension spring applied over an equalizer cam so that the spring tension is uniform at any elevation of the blade. The spring is adjustable to suit the load. The drawbars are hooked up to a "Universal" connection.

Timken bearings are used in front wheels. The tractor connections are centrally located. The grader unit is pivoted centrally to the track frame with stops in front and rear. The operator's platform is made of checkered plate and spring mounted. The metal cab may be entirely enclosed. The scarifier attachment is independent of the blade.

A snow plow attachment may be furnished, which makes the Russell an all season unit. The weight with scarifier is 8,850 lbs.; the wheelbase is 210 inches; the tread, front, is 52 inches; the tread, rear, is 42 inches.

Glass-Steel Sludge Bed Enclosures

The Barns Engrg. Co., Inc., N. Y., manufactures glass-steel enclosures designed exclusively for covering sewage sludge drying beds. The advantages of such equipment are numerous. Engineers have found that the area of sludge beds can be reduced to one-half, and in some cases to one-third, that required when uncovered beds are used. Better operation is possible, since the effect of unfavorable weather conditions is largely eliminated. Odors are reduced, or may be eliminated by drawing off the gases through a ventilating pipe. Covering the beds greatly improves the appearance of sewage treatment plants and reduces complaints.

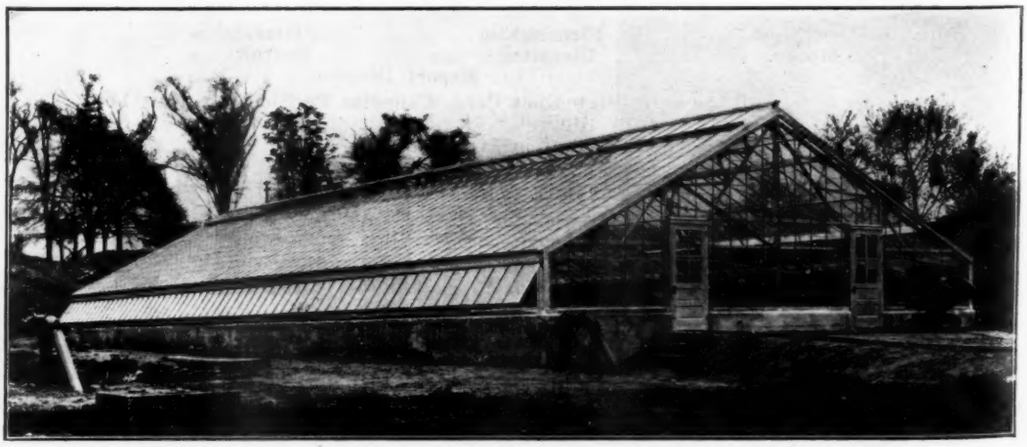
Similar coverings have been tried out with success on sprinkling filters.

The Barns equipment is claimed to meet the severe conditions resulting from this work, such as destructive moisture. corrosive gases, extremes of temperature, heavy winds and snow loading. Glass-steel frames are designed to carry the weight of the glass roof plus not less than 30 pounds per square foot combined wind and snow load. These enclosures may be built to conform for any special requirements, or to any desired sizes.

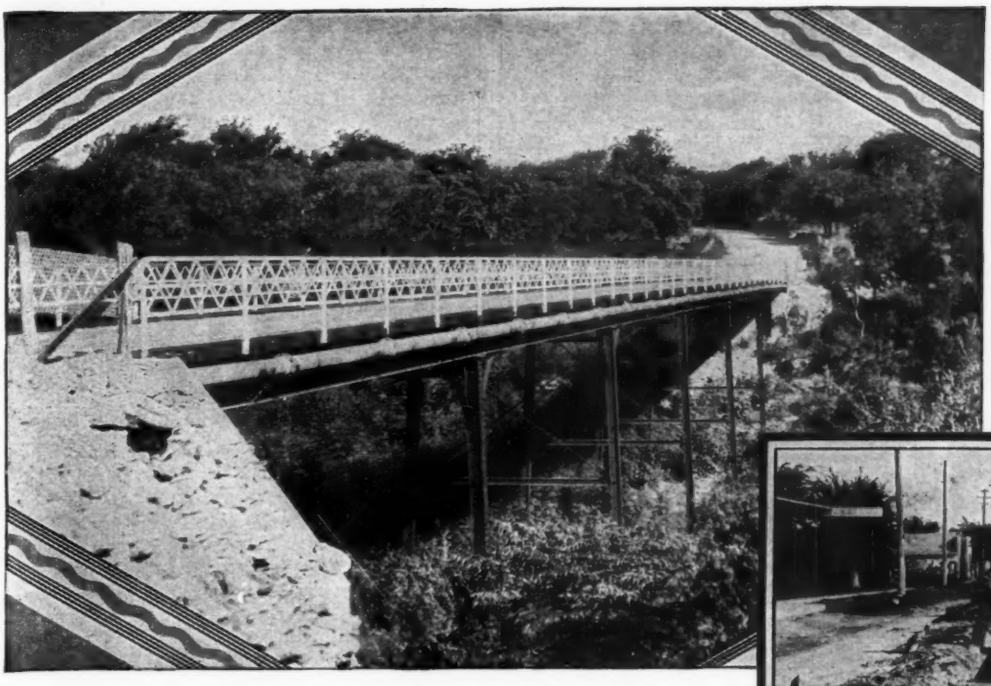
Mixer Tank for Water Cement Ratio

The T. L. Smith Company, Milwaukee, Wis., has developed a new type of water measuring tank for use in Smith pavers.

For the new tank it is claimed by the manufacturers that accuracy to the ounces is obtainable. The design follows



GLASS-STEEL SLUDGE BED ENCLOSURE AT LODI, N. J. 40' X 100'



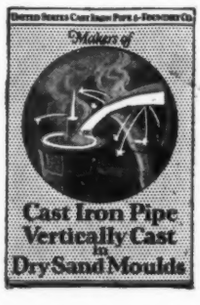
Eight-inch Anthony Joint deLavaud gas pipe line suspended on bridge across Colorado River at Austin, Texas

To reduce installation costs Anthony joint pipe is available in 24-ft. lengths made up of two standard lengths welded and tested under ideal conditions at our plant

No leaks occur in *this* bridge crossing

EACH year there is added proof of the soundness of deLavaud cast iron pipe with the Anthony joint for gas and water service. The Austin Gas Co. installed the 8 in. deLavaud main illustrated above in 1926. Where this line crosses the Colorado River Bridge, conditions are unusually severe, due to peculiar strain and constant vibration. That leakage has never developed is practical evidence of the great tensile strength of deLavaud pipe and the flexibility of the Anthony joint.

In modern high-pressure gas lines this type of installation has proved widely satisfactory. Under daily pressures of 90 to 125 lbs. leakage can be practically eliminated. DeLavaud pipe gives pressure-proof tightness, combined with ease of installation, and the age-defying economy of good cast iron.



MAY WE SEND YOU LITERATURE COVERING USES and LATEST SPECIFICATIONS OF DeLAVAUD CENTRIFUGAL PIPE

United States Cast Iron Pipe and Foundry Company

General Offices:
Burlington, New Jersey

Philadelphia: 1421 Chestnut St.
Chicago: 122 So. Michigan Blvd.
Birmingham: 1st Ave. & 20th St.
Buffalo: 957 East Ferry Street
Cleveland: 1150 East 26th Street
New York: 71 Broadway
San Francisco: 3rd & Market Sts.

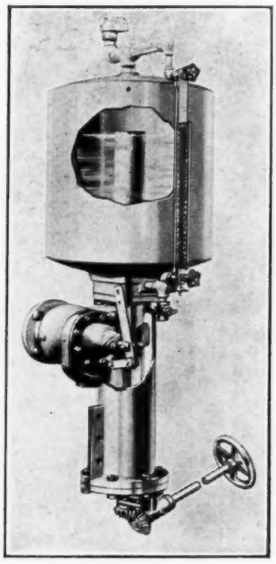
Los Angeles: 403 So. Hill St.
Pittsburgh: 6th & Smithfield Sts.
Dallas: Akard & Commerce Sts.
Kansas City: 13th & Locust Sts.
Seattle: 1st & Marion Sts.
Minneapolis: 6th Street & Hennepin Avenue

the practice of manufacturers of pumps used in measuring liquids for sale as in gasoline filling stations. The claim is made also that the accuracy of the tank is unaffected with the paver operating on a side or up or downhill slope. Slope has been an important cause of inaccuracy in water tanks in the past.

Recent exhaustive tests on all makes of paver tanks by a state highway department have indicated unusually fast emptying and have borne out the claims for accuracy unaffected by slope.

The amount of water discharged is varied by raising or lowering a central pipe of large diameter. A convenient hand wheel on the operator's platform permits of regulation to the ounce. The tank and valve are self-cleaning and the regulating parts are non-rusting.

The new tank has been furnished on Smith pavers shipped during the current year.



SMITH MIXER TANK

Loadmaster Swing Crane

Frederic H. Poor, Inc., New York, has developed the Loadmaster Crane, which has been designed to meet the growing need in the industrial field for a small locomotive type crane of general utility. It is a swinging crane of moderate price, capable of handling loads which cannot be advantageously handled by manual labor; which are either too small to justify the installation of large and costly crane units, or loads which, by reason of their location, are not within reach of ordinary hoist service.

The loadmaster is mounted upon an industrial tractor. It moves from place to place under its own motive power, and the power for lifting and swinging loads is derived through the power takeoff from the tractor engine. With these characteristics, the loadmaster provides a range of usefulness far beyond the limitations of the ordinary crane unit. Furthermore, it may be used to haul loads or trailers attached to the tractor upon which the crane is mounted.

The frame, upon which the mast is located, consists of a fabricated plate and channel structure secured at the rear to the axle-housing of the tractor, and is suspended at the front in such a way as to compensate for irregularities in the floor or roadbed over which the machine travels.

The hoisting drum is directly connected to a self-locking worm gear, and is operated from the power takeoff through a clutch and bevel pinions by a control lever within easy reach of the driver. When the drum is not in motion the self-locking worm gear holds the load in suspension on the boom without the use of a friction brake.

The swinging boom is constructed of two steel channels firmly braced together and equipped with necessary sheaves and hook weight. The "bull wheel," by which the boom is swung about the mast, is power driven by means of chain and sprocket, and is equipped with an expanding brake of such design that the boom may be controlled in its swing, or, when not under power, be set in any fixed position.

Maximum loads can be lifted at short outreaches, as is usual with all swing cranes: the lifting capacity is greatest with the boom directly forward. The full swing-arc of the boom under load is approximately 240 degrees; i. e., 120 degrees either side of the forward position. Adjustable telescoping outriggers allowing heavier loads to be swung over the sides can be furnished. These outriggers may be folded alongside the machine when not in use.

This unit is especially adapted to cleaning catch basins, laying and handling water or sewer and culvert pipe, and for general municipal work.

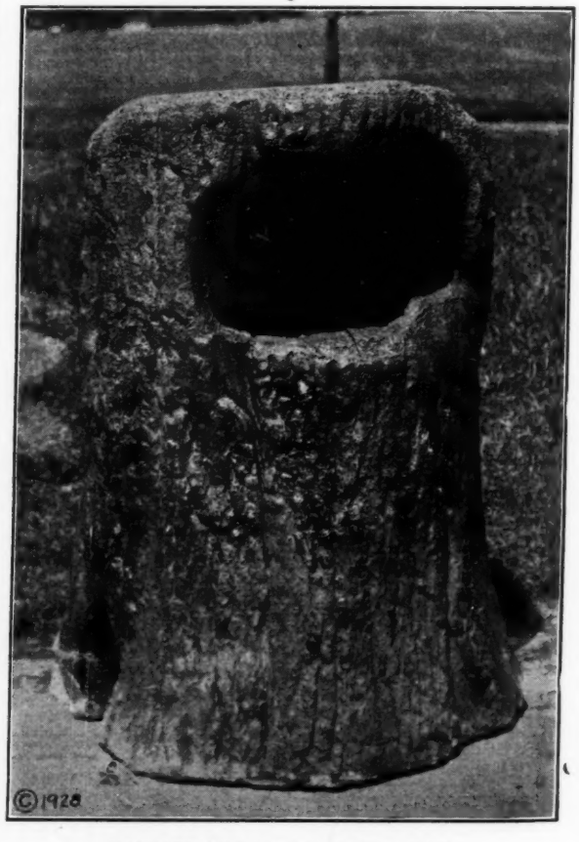
LOADMASTER SWING CRANE

Concrete Tree Trunk Incinerator

The Municipal Products Co., New York City, have developed an incinerator especially designed for use in parks, parkways and suburban streets. This incinerator, which is constructed of a high temperature resisting concrete compound, blends with the general park scheme, but is a most practical device. Its use eliminates the necessity for the usual type of refuse containers, which require frequent emptying, with resultant spillage of wastes.

It is constructed of concrete which is colored and shaped to harmonize with the surroundings. It is equipped with a grate, to prevent burning leaves or refuse from dropping on the walks or pavements. Draft holes are provided at the bottom.

A large number of these incinerators are used in the parks of the larger cities. New York uses several hundred in Central Park and Riverside Drive; Boston also uses them, as does Jacksonville, Fla.



INCINERATOR FOR PARK USE

Steel Grit for Core Drills

The American Steel Abrasives Co., Galion, O., manufacture steel grit for use in core drill work in cutting out test sections of pavements. Steel grit is simply crushed steel shot carefully screened to standard size. The cost is about the same as steel shot, but grit, it is claimed, offers sharp cutting edges while steel shot is round and smooth. No. 8 grit which just passes through an 8-mesh screen (opening .093") is the size usually used for core-drill work.

Extensive use by the Ohio State Highway Department has shown, it is said, that steel grit cuts much faster than steel shot; shot was always very slow on brick; with grit, it is claimed, a 2½" brick can be cut through in seven minutes. Gravel concrete is usually very hard to cut through since most gravels contain some very hard pebbles. Eight to 10 cores is considered a good day's work in this material. With grit 12 to 15 cores is an average day's work, it is stated.

The steel grit feeds well and costs about the same per pound as steel shot, and very much less per core.

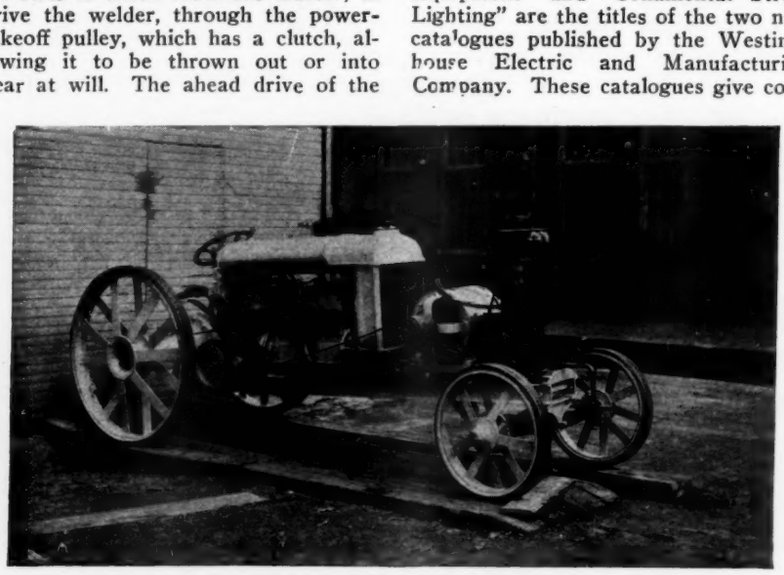
Generous test samples of No. 8 steel grit, will be sent without obligation, to any core-drill user who desires to test the material.

Electric Arc Welder Mounting

The Pontiac Tractor Co., Pontiac, Mich., has announced a new mounting of the standard Lincoln Electric stable arc welders. The welder unit with stabilizer and panel are mounted on a frame, which attaches to either the McCormick-Deering 10/20 or Fordson Tractors. This mounting of the Pontiac Lincoln arc welder, gives a four wheel rubber tired self-propelled unit, capable of hauling heavy leads behind itself. This unit is also mounted on crawlers for soft ground work.

Power is taken from the tractor, to drive the welder, through the power-takeoff pulley, which has a clutch, allowing it to be thrown out or into gear at will. The ahead drive of the belt, brings the belt tightener into the correct relation with the belt.

The manufacturer states, that a number of these units have been put out as special equipment, over a period of four years, and have proven very successful on pipe line construction and structural steel fabricating showing considerable saving, over former methods of welding.



PONTIAC LINCOLN ARC WELDER

TRADE PUBLICATIONS

American Vitrolithic Corporation, Des Moines, Ia. An illustrated booklet describing "armor-plated compressed concrete pavements." Describes in detail and by picture methods of construction of this pavement.

The Otto Engine in Industry. — The Otto Engine Works has just published "Non-Technical Booklet B," which should be of special interest to executives.

Sullivan Machinery Co., Chicago, Ill.— Sullivan "K-3" Concrete Breaker, described in Bulletin 81-U, 8 pages. The "K-3" is a powerful and substantial compressed air tool for concrete breaking of the heaviest and most difficult kinds. It weighs 84 lbs. and employs a cylindrical hollow valve for imparting the impulses of air to the piston. In everyday service, air economy and excellent standup qualities are claimed for this machine, as well as great power and penetration.

Inspecting Creosated Piles and Poles.— The Pittsburgh Testing Laboratory, Pittsburgh, Pa., has put out a booklet which gives much valuable data regarding the inspection of creosoted pine poles and piles. It describes the methods of treating by creosote and the details of inspection.

New Westinghouse Street Lighting Catalogues.—"Overhead Street Lighting Equipment" and "Ornamental Street Lighting" are the titles of the two new catalogues published by the Westinghouse Electric and Manufacturing Company. These catalogues give complete information on all street lighting equipment and appliances manufactured by the Westinghouse Company, and in addition describes and illustrates the equipment with photographs, dimensioned line drawings, charts, and line drawings with each part labeled.

Pneumatic Tools.—The Ingersoll-Rand Co., New York, has brought out a most complete catalog of all their pneumatic tools and appliances, including chippers, core-breakers, diggers, riveters, drills, grinders and saws, hoists, sand rammers and accessories. All are bound within a strong paper cover.

Link-Belt Co., Chicago, Ill.—The Crawler Crane Book No. 995 just issued by Link-Belt Company covers the complete Link-Belt line of gasoline, diesel and electric crawler cranes of capacities up to and including the 2 cu. yd. heavy duty machine as well as standard locomotive cranes. The book is illustrated to show the use of the dragline, dipper and trench shovels, skimmer scoop, hook block, pile driver, and other attachments which may be used without changing or disturbing the bodies of the machines. Data on lifting capacities, approximate operating speeds, line pull, tractive effort, etc., are given. The tables in which these data is arranged have been supplemented by line drawings which show dimensions for operating limits.

Sullivan Machinery Co., Chicago, Ill.— Sullivan "L-8" Rotator drill, described in Bulletin 81-T. The "L-8" is a 39-lb. one man Rotator drill for all around rock drilling service, in a range as wide as from shot holes in anthracite mining, to general purpose drilling in quarries, and on contract work. Simplicity, relative freedom from vibration, and consequent ease of handling, are claimed as desirable features. The machine may be mounted on a cradle and shell for use on a mining column, or on a tripod for deeper down holes. It may be equipped with water tube and jet for work of this sort. A hollow piston and hole cleaning device are features of this machine, as regularly supplied.

Littleford Bros., Cincinnati, O.—A complete catalog of road maintenance equipment. Oil burning kettles, wood and coal burning kettles, tool heaters, sand dryers, portable tool boxes, grout mixers, etc., are properly arranged and clearly indexed in this new catalog. Highway officials, supervisors and contractors will find this an interesting catalog. It may be obtained either through PUBLIC WORKS or by writing direct to Littleford Bros., 452 East Pearl Street, Cincinnati, Ohio.

Caterpillar Tractor Co., San Leandro, Calif., and Peoria, Ill. "Caterpillaar Power for Factories: 28 pages, illustrated. Condensed data for use of factory superintendents, engineers, contractors and executives. "Caterpillar Power for Public Utilities: Gas, water, light and power companies are extensive users of "Caterpillar" tractors and this 40-page illustrated book pictures the methods

worked out in practice in all parts of the world. "Caterpillar Power for Railroads": 20 pages, illustrated. The story of the Southern Pacific Railroad's freight yard at Fresno, where new methods cut time a fourth and costs a third. "Caterpillar Power for Mines and Quarries": 24 pages, illustrated. Shows how the more progressive companies are mining gold, cement, glass, copper, coal, phosphates, etc.

INDUSTRIAL NOTES

The largest pump that has ever been constructed by The Pomona Pump Company of Pomona, California, has just been installed and is in operation for the Etiwanda, Cal., Water Company. This pump is said to break all records in size

LARGEST POMONA PUMP

and lift. The weight of the pump is 60,000 pounds. It is installed in a well of 450 feet depth, and not only raises the water from this depth, but boosts it an additional 190 feet, making a total head of 640 feet. The water is boosted to a hill where it is redistributed to lines and laterals for use in irrigating.

The Chas. T. Topping Machinery Company, manufacturers of excavating machinery, announce the removal of their offices from the U B Building, Dayton, Ohio to 4403 St. Clair Ave., Cleveland, Ohio.

In an effort to make it easier for drivers of all motor vehicles to say "NO," Mack Trucks Inc., manufacturers of trucks and buses have devised a clearly visible though inconspicuous sign which states its message in concise yet courteous language *"Sorry! No Lifts. Avoid Risk."* Any reasonable amount of these small stickers will be forwarded free if the request is mailed to Advertising Department, Mack Trucks, Inc., 252 West 64th St., New York City.

The Interstate Drop Forge Co., Milwaukee, Wis., has issued "Die-ology," which is an explanation of modern die construction and board drop hammer operation.

The general sales and advertising offices of the Universal Crane Co., has been moved from Cleveland to Lorain, O.

The National Paving Brick Manufacturers' Association has removed the headquarters of the association to the National Press building, Fourteenth and F streets, Washington, D. C.

The FWD truck business for the first seven months of 1928 increased 24% over the same period last year, according to a recent announcement by the Four Wheel Drive Auto Company of Clintonville, Wisconsin.

Four new plants of the Linde Air Products Co. have recently started production of oxygen; Harrisburg, Pa., in charge of J. J. Naber; Allentown, Pa., in charge of W. Barber; Shreveport, La., in charge of F. T. Rueger; Charleston, West Virginia, in charge of Ed Pohlman.

The Prest-O-Lite Co., Inc., has added two new plants, as follows: Harrisburg, Pa., in charge of H. A. Smith, and Allentown, Pa., in charge of J. W. Summers.

Highway Bridges, Inc., of 57 William Street, New York City, has been organized for the purpose of financing, constructing and operating highway toll bridges in various sections of the United States. P. K. Schuyler is Chief Engineer of this organization.

The Byers Machine Company, Ravenna, Ohio, announces the physical consolidation of its Massillon, Ohio, plant with the one at Ravenna, where production of power shovels, cranes and ditching and grading equipment will be expanded. The adjoining 15-acre site, until recently occupied by the National Carbon Company, has been secured. The eenlargement program also includes a large testing ground. Little new building will be required, due to rearrangement of the old Ravenna plant and expansion on the former National Carbon Company site. The Massillon plant is to be closed immediately, removal of equipment and inventory having been carried on for a number of weeks. The line ranges from the ⅝ to the 1¼-yard size.

The City of Seattle recently purchased a 33,000 kv-a. waterwheel generator from the Westinghouse Electric and Manufacturing Company, as a third unit for the Gorge Plant of that city. The new generator will be rated at 11,000 volts, running at 257 rpm. Units one and two, purchased from Westinghouse several years ago, are each rated at 30,000 kv-a., making a total capacity of 93,000 kv-a. with the addition of the new unit.

The Chain Belt Company, Milwaukee, Wis., has started work on a new manufacturing building on its 59 acre tract at 39th and Orchard Street, Milwaukee. This is the fourth unit to be erected and is a part of a general plan for extension. The new building will be 104 by 150 feet.

The ratio of the operations to the capacity of the American Portland cement industry during the month of August was 93.1 per cent, according to figures released by the Bureau of Mines of the Department of Commerce. During the month 18,730,000 barrels were produced, 21,970,000 barrels were shipped, and there were in stocks on hand at the end of the month 19,340,000 barrels. Production in August, 1928 was 2.3 per cent more, and shipments 2.6 per cent more than in August, 1927. Stocks at the mills were 18.7 per cent higher than a year ago.

The Austin-Western Road Machinery Co., has just entered its seventieth year of service. The first road-building machine—a wooden frame drag scraper—was put in service in 1858. At this time there were no railroads west of the Mississippi, and practically no roads. With the aid of these first road machines, paths and trails were turned into roads for the westward migration. In 1877, the Western Wheeled Scraper was put on the market, and its introduction marked the beginning of economics in excavating and grading work.

AUSTIN-WESTERN ORIGINAL WESTERN WHEELED SCRAPER—1877